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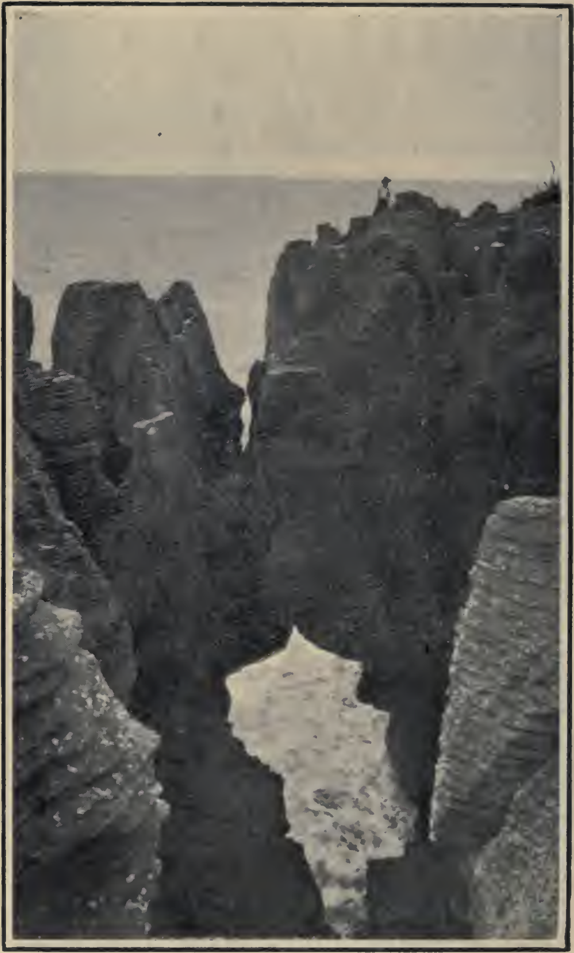

Remarkable Coast Rock Formation. Blowhole, Punakaikai, West Coast. [*H. C. Pearl, photo*

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THE PACIFIC

GEOGRAPHY

(Physical, Mathematical, Political, Social and
Commercial)

STANDARD VI.

Specially written to meet the requirements of the
New Zealand Syllabus of Instruction

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AUCKLAND CHRISTCHURCH, DUNEDIN & WELLINGTON, N.Z.
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PREFATORY NOTE TO THE SERIES.

This revised edition of the PACIFIC GEOGRAPHIES is designed to provide a complete course of instruction in Geography for each of the Standards of the Middle and Senior Divisions, as prescribed by the New Zealand Syllabus. The books will therefore be found to contain all the required Physical, Mathematical, Political and Commercial Geography, treated with sufficient fullness to furnish teachers with a wide choice in the arrangement of their programmes of instruction.

Special stress is laid throughout upon observational and experimental work, as well as upon other forms of individual effort, as aids to sound geographical teaching. The large number of pictures, maps, and diagrams in the various books of the Series will also, it is hoped, prove of interest and service both to teachers and pupils.

Limits of space unfortunately preclude the further treatment in this book of a variety of topics which have been dealt with in the books for earlier standards. For the Geography of New Zealand and Australia pupils are also referred to earlier numbers of the series.

CONTENTS

PAGE

Part I.—Physical Geography

1. The Scale of Maps .. 9
   1. Australia 10
   2. India 12
   3. Great Britain .. 12
2. Topographical Maps .. 14
   1. Contours 16
   2. Hachures 18
3. Map Reading 19
   Questions and Examples .. 21
4. Experiments with Ice
   1. Temperature of Melting Ice 23
   2. Latent Heat .. 24
   3. Ice Formed by Rapid Evaporation .. 25
   4. Expansion of Water when Freezing .. 25
   5. Volume & Density of Ice Compared with those of Water .. 26
   6. Ice Surfaces in Contact —Regelation .. 27
   7. Water when Freezing Expands with Great Force — Fracture of Rocks 27
5. Glaciers & the Work of Ice—
   1. Glaciers and Rivers .. 30
   2. Valley Glaciers .. 31
   3. Moraines 33
   4. Crevasses 35
   5. Work of Glaciers .. 37
   6. A Glacier's Rate of Flow 38
   7. Distribution of Glaciers 38
   8. New Zealand Glaciers 39
   Experimental Hints .. 42
6. Work of Ice and Snow in Shaping the Land Surface—
   1. Crumbling of the Land 43
   2. Affecting Shores of Lakes and Rivers .. 45
   3. Affecting Coasts — Sea Ice 46
7. Effects of Glacial Action on Cultivation and Settlement .. 47
8. Icebergs 49
9. Pressure of the Atmosphere
   1. Air Pressure .. 50
   2. High and Low Pressure 52
10. Winds—
   1. General Causes .. 54
   2. Trade Winds .. 56

PAGE

   3. Land & Sea Breezes .. 56
   4. Monsoons 57
11. Work & influence of Winds—
   1. Distribution of Temperature .. 58
   2. Distribution of Moisture 58
   3. Other Work .. 60
12. Radiation—
   1. How the Air is Heated and Cooled .. 61
   2. Effect of Long or Short Days and Nights .. 63
   3. Effect of Inclination of Sun's Rays .. 64
13. Climate—
   1. Weather and Climate 66
   2. Causes of Difference of Climate 67
      (1) Influence of Latitude 68
      (2) Influence of Elevation 71
      (3) Influence of Large Land or Water Areas .. 72
      (4) Influence of Prevailing Winds and Ocean Currents, etc. 74
      (5) Influence of Mountain Chains .. 77
      (6) Influence of Soil, Cultivation and Forests .. 78

Part II.—Mathematical Geography

1. The Earth's Daily Rotation 79
2. The Earth's Axis .. 83
3. Day and Night .. 84
4. Meridians 85
5. Longitude 87
   1. Varying Lengths of Degrees of Longitude 88
   2. Local Time & Longitude 90
   3. Longitude at Sea . 91
6. Latitude 93
7. How to find Length of a Degree of Longitude.. 96
8. Spherical Form of Earth 98
9. Stable Position of the Earth's Axis .. 99
10. Annual Revolution of Earth 100
11. Meridian Altitude of Sun at Equinoxes and Solstices 102
12. How to find Latitude of School 105

PAGE
13. Inclination of Earth's Axis 107
14. Lengths of Day at different Seasons .. 108
15. Lengths of Day and Night at Poles .. 112
16. The Seasons 113

Part III.—Asia and America—

1. Asia—

1. Introductory .. 114
2. Contrasted with Europe 116
3. Relief 116
4. Rivers 119
5. Deserts 119
6. Climate 120
7. Rainfall 121
8. Races of Asia .. 122
9. Chief Countries of Asia 123
(1) Asiatic Russia .. 124
(2) China
1. Area and Population .. 124
2. Products and Industries .. 125
3. Chief Towns .. 125
(3) Asiatic Turkey
Area & Population .. 125
(4) Persia 126
(5) Afghanistan .. 126
(6) Arabia 126
(7) The Malay Archipelago 127

2. North America—

1. Introductory .. 127
2. Compared with South America 127
3. Relief 127
4. Rivers 128
5. Climate & Rainfall .. 128
6. Chief Countries .. 130
(1) Mexico 130
(2) Central America .. 131
(3) West Indies .. 131

3. South America—

1. Introductory .. 132
2. Relief 132
3. Rivers and Lakes .. 132
4. Climate and Rainfall .. 134
5. Chief Countries .. 135

Part IV.—The British Empire—

1. The United Kingdom—

1. Situation, etc. .. 136
2. Surface 137
England .. 138
Scotland .. 139
Ireland .. 141
3. Climate 142
4. Influence of Climate on Agricultural and Pastoral Industries .. 144
5. Distribution of Population 145
6. People and Language 147
7. Table of Coalfields and Industries .. 148
8. Manufacturing & Other Industries .. 148
9. Sources of Food Supply 156
10. Other Imports .. 157
11. Exports 158
12. Commerce 159
13. Internal Communication 160
14. Defence 160
2. Other British Territory in Europe 160

3. The British Dominions in America—

1. Dominion of Canada .. 162
(1) Area & Population 162
(2) Commercial Position 164
(3) Surface 164
(4) Climate 165
(5) Commerce and Industries .. 167
(6) Provinces and Chief Towns .. 171
(7) The People of Canada .. 174
(8) Historical Outline .. 175
2. Newfoundland .. 176
3. British West Indies, etc. 178

4. The British Territory in Africa—

1. The Union of South Africa 181
(1) Provinces .. 181
(2) Government .. 181
(3) Area and Population 181
(4) Surface 182
(5) Commercial Position 184
(6) Climate 184
(7) Industries and Commerce 186
(8) Internal Communication .. 188
(9) Historical Outline .. 188
(10) Chief Towns .. 189
(11) Protectorate of South-West Africa 191
2. Rhodesia, etc. .. 191
3. British East Africa .. 193
4. British West Africa .. 194
5. Egypt and the Sudan .. 196

5. The British Territory in Asia—

1. The Indian Empire—

PAGE
(1) Position and Area .. 198
(2) Commercial Position 200
(3) Surface 200
(4) Internal Communication 202
(5) Climate 202
(6) Industries and Commerce .. 203
(7) Government .. 206
(8) Historical Outline .. 207
(9) Chief Cities & Ports 208
2. Other British Territory in Asia 210
6. British Territory in the South Seas .. 214

Two Countries of Special Importance to British People—

1. The United States of America 216
2. Japan 224
Appendix: Chief Trade Routes of the World 227

LIST OF ILLUSTRATIONS.

Blowhole, Punakaikai, West Coast ... ... *Frontispiece*

PAGE
Map of Australia .. 11
Map of India 13
Map of Great Britain .. 15
Section and Contours of Hill 16
Sketch and Contour Map .. 17
Section, Contours, and Contours with Hachures .. 19
Ordnance Survey Map Symbols 20
Symbols illustrated in Map .. 21
An Ordnance Survey Map .. 22
Centigrade and Fahrenheit Thermometer Scales .. 23
Measuring Glass 25
Regelation Experiment .. 28
Mount Cook and Hochstetter Icefalls 30
Tributaries of the Tasman Glacier 32
Moraines 33
Mueller Glacier 34
A Stone Striated by Glacial Action 35
Looking into a Crevasse .. 36
Franz Josef Glacier .. 37
Measuring a Glacier's Rate of Flow 39
How Icebergs are Formed .. 40
Map of Mount Cook Glaciers 41
Castlehill Rocks 44
Terraces Cut by Glaciers .. 48
Maunga-Ma and Mt. Thomson and Donne Glacier .. 49
An Antarctic Iceberg .. 50
Air Pressure Experiment .. 51
Mercurial Barometer .. 52
Land and Sea Breezes .. 55
Prevalent Winds of the Globe 56
Section of India in Path of Wet Monsoon .. 58

PAGE
An Eroded Sentinel .. 59
Sandhills, Victoria .. 60
Equal Groups of Rays at Equator and at Pole .. 64
Comparative Heating Effects of Rays at Midsummer and Midwinter .. 65
Division of the World into Zones 68
Wetter and Drier Sides of Mountains 75
Floods at Foxton 79
Position of same Bright Star at intervals of time .. 82
Appearance of the Earth if it did not Rotate .. 84
Parallels and Meridians .. 86
A Ship's Chronometer .. 92
Eclipse of the Moon .. 99
Circular Path Described by Observed Star .. 101
Earth in Four Positions in Relation to Distant Star 102
Meridian Altitude of Sun at Wellington 103
Wooden Quadrant 104
Apparent Path of Sun Across Sky 106
The Seasons 113
Relief Map of Asia .. 115
Map of Asia 118
Rainfall Map of Asia .. 122
Relief Map of North America 129
Relief Map of South America 133
Mountains, Rivers, Winds, & Rainfall of S. America .. 135
Contour Map of British Isles 137
British Isles (physical) .. 140
Rainfall Map of British Isles 144

PAGE
British Isles (principal products) 146
Map of England and Wales 149
British Coal and Iron Fields 150
Map of Scotland 151
Map of Ireland 152
George Square, Glasgow .. 153
Weaving Room in Linen Mill, Belfast 155
Map of the World showing British Empire, facing page 160
Map of Canada 163
Wheat Elevator, Canada .. 168
Canada and United States of America (products) .. 170
Quebec from the St. Lawrence River 171
Montreal from Mount Royal 173
Where Train & Steamer Meet 175
Map of British West Indies, etc. 179
A North and South Section Across South Africa .. 183
Waterfalls, Natal .. 185
Egypt, etc. (principal products) 186
Plucking an Ostrich .. 187
Cape Town & Table Mountain 190
Map of Africa 193
Open Sluices of Assouan Dam 197
Map of India 199
Colombo Breakwater .. 201
India & Burma (products) .. 203
Bamboos 205
Bombay Harbour 209
Simla 210
Dredging for Tin, Straits Settlements 212
A Native Dwelling, Samoan Islands 215
Map of United States .. 219
Cotton Picking, Georgia, U.S.A. 220
Irrigating Oranges, California 221
Buildings in New York .. 222
Sugar for Export, New Orleans 223
Japan and Korea .. 225
Trade and Cable Routes .. 228

THE
PACIFIC GEOGRAPHY

STANDARD VI.

PART I.—PHYSICAL GEOGRAPHY.

1. THE SCALE OF MAPS.

1. Correctly drawn maps are intended to show, on a small scale, the shapes, relative sizes, and positions of different portions of the Earth's surface. If we know the scale to which a map is drawn, then, from the measured distance between any two places on it, we may easily calculate the actual distance they are apart, or their distances from other places indicated on the map. We may also readily ascertain the length or breadth, or the approximate area of any country or continent, by using some such method as that indicated below; or by making an intelligent use of the scale of miles shown on the map itself; or of the lines of latitude and longitude which are drawn through it. The latter will usually be found marked in degrees at the top, bottom, and sides of the map.

2. Usually, where the surface represented on a map is not very large, comparatively, the whole of the map is drawn to the same scale; but where the surface to be shown is very large, as that on a map of the world, sometimes we make use of different scales for different portions of the same map. It is

by means such as these that we attempt to lessen the difficulty of representing on a flat piece of paper the outline and measurements of a curved surface.

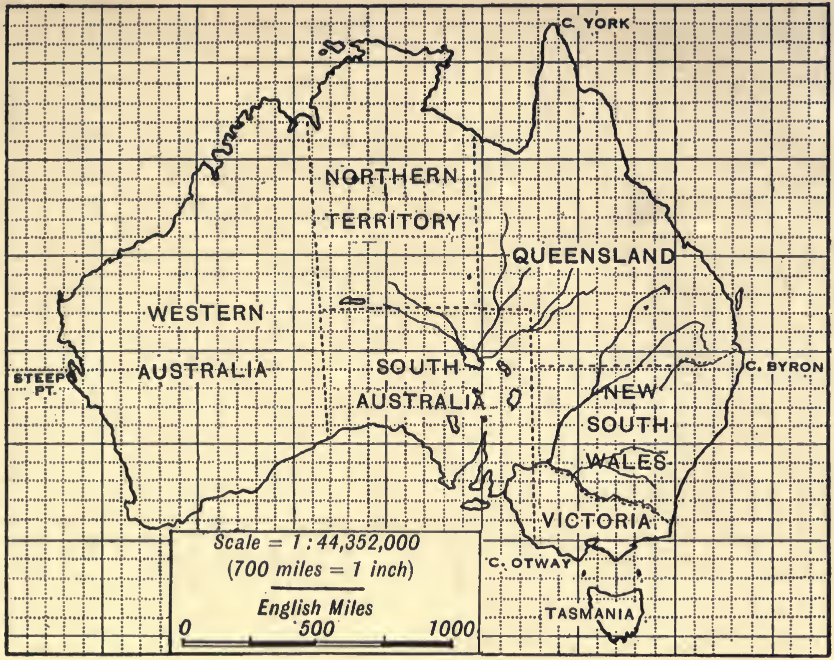
3. Different maps of the same country or continent may, of course, be drawn to different scales. Most of the maps in this book, for instance, are of about the same size; but, as they represent areas differing in dimensions, very few of them are drawn to exactly the same scale. Although, in the maps of Australia and India, on pages 11 and 13, India appears to be nearly as large as Australia, in reality it is little more than half the size of the latter; for about one inch on the map of India represents a length of 527 miles, while on the map of Australia referred to one inch represents roughly a distance of 700 miles.

4. If we wish to show to the eye merely the relative sizes of different countries or continents,—that is, to indicate by how many times one is greater or smaller than another—we may draw them all to the same scale.

1. Scale of the Map of Australia.

On the map of Australia, referred to above, the length of the continent from Cape York to Cape Otway measures about $2\frac{8}{10}$ inches, and the breadth from Steep Point to Cape Byron measures $3\frac{1}{2}$ inches. The actual length of the former distance has been found to be about 2,000 miles, and of the latter, about 2,400 miles. That is, 1 inch on the map represents roughly a linear distance of about 700 miles; or $\frac{1}{10}$ of an inch (the length of the side of each of the little squares) is equal to about 70 miles. In other words, the scale of the map is 700 miles to the inch.

A square inch (four larger squares on this map) therefore, represents approximately an area of some $700 \times 700 = 490{,}000$ square miles of land or water surface; and each little square, or $\frac{1}{100}$ of a square inch, indicates 4,900 square miles.



MAP OF AUSTRALIA

SHEWING HOW LENGTH, BREADTH AND AREA MAY BE ESTIMATED.

Side of each small square $= \frac{1}{10}$ in.

Area of each small square $= \frac{1}{100}$ sq. in.

Side of each large square $= \frac{1}{2}$ in.

Area of each large square $= \frac{1}{4}$ sq. in.

4 large squares = 1 sq. in.

---

1 inch = 700 miles nearly

$\frac{1}{10}$,, = 70 ,, ,,

1 sq. inch = 700 × 700 = 490,000 sq. miles

$\frac{1}{100}$ sq. inch = 4,900 square miles

607 small squares = 4,900 × 607 = 2,974,300 sq. miles

Actual area of Australia = 2,974,581 sq. miles

Count the number of little squares on the map covered with the outline of Australia (including Tasmania), and, (estimating fragments) there will be found to be altogether 607 of these. As each little square represents 4,900 square miles, the total area of Australia should be 607 × 4,900 = 2,974,300 square miles. The actual area of the Commonwealth has been ascertained to be 2,974,581 square miles, so that our map and measurements are tolerably correct.

2. Scale of the Map of India.

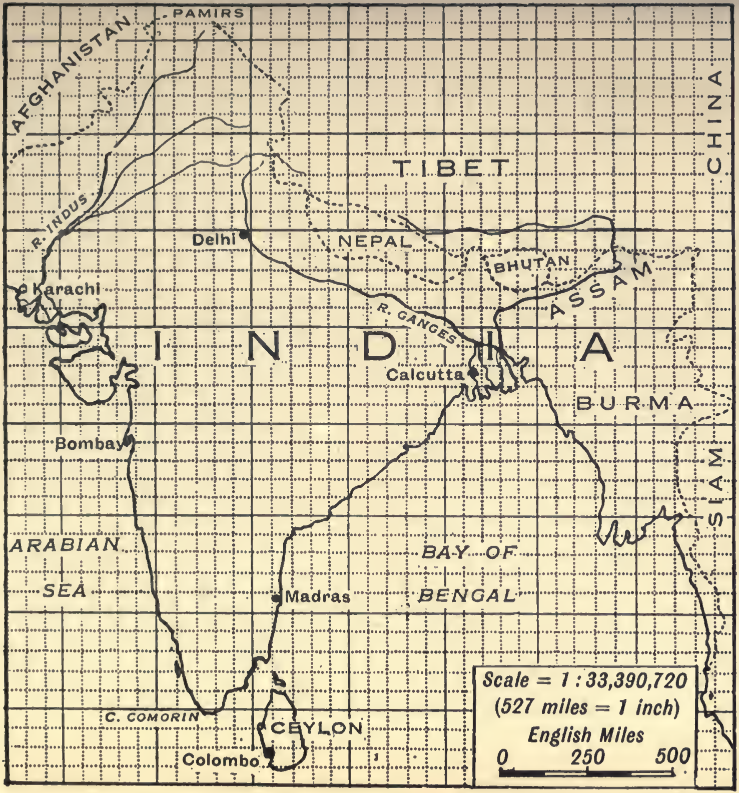
On the map of India on the opposite page the length of the country from Chitral or the Pamirs, in the north, to Cape Comorin, in the south, is $3\frac{7}{10}$ inches, representing an actual distance of about 1,950 miles; while the breadth from the frontier near Karachi to the north-east of Assam, is $3\frac{6}{10}$ inches, indicating a distance of about 1,900 miles. That is to say, 1 inch on the map represents a distance of about 527 miles; and $\frac{1}{10}$ of an inch, a length of 53 miles. The side of each of the little squares on the map is $\frac{1}{10}$ of an inch long; therefore 1 sq. inch on the map stands for 527 × 527 = 277,729 square miles; $\frac{1}{4}$ of a square inch (one of the larger squares) indicates 69,432 square miles; and $\frac{1}{100}$ of a square inch (one of the little squares) represents 2,777 square miles of actual area. (Notice that 25 little squares equal 1 larger square, and 4 larger squares equal one square inch.)

Count the number of little squares (including the fractions thereof) comprised within the outline of India on the map, and it will be found that there are some 638 of them. Now, 638 × 2,777 = 1,771,726 square miles, which gives us approximately the area of India; the actual area being about 1,774,000 square miles.

3. Scale of the Map of Great Britain.

(1) Measure the length of Great Britain (England and Scotland) on the map on page 15, and it will be found to be about $4\frac{1}{5}$ inches. Actual measurements have shown that the greatest length of Great Britain is about 600 miles. The scale of this map is, therefore, 143 miles to an inch. A square inch on the map therefore stands for an actual area of 143 × 143 = 20,449 square miles.

(2) The sides of each little square on the map are $\frac{1}{10}$ of an inch long; the area of each is therefore $\frac{1}{10} \times \frac{1}{10} = \frac{1}{100}$ of a



MAP OF INDIA

SHEWING HOW LENGTH, BREADTH AND AREA MAY BE ESTIMATED.

Side of each small sq. = $\frac{1}{10}$ in.
Area ,, ,, = $\frac{1}{100}$ sq. in.
Side of each large sq. = $\frac{1}{2}$ in.
Area ,, ,, = $\frac{1}{4}$ sq. in.
4 large squares = 1 sq. in.

---

1 inch = 527 miles
$\frac{1}{10}$,, = 53 ,,

---

1 sq. in. = 527 × 527 sq. miles
= 277,729 ,, ,,
$\frac{1}{4}$,, ,, = 69,432 ,, ,,
$\frac{1}{100}$,, ,, = 2,777 ,, ,,

---

638 small squares = 2,777 × 638
= 1,771,726 sq. miles.
Actual area of India = 1,774,000 square miles.

square inch. Therefore, the actual area represented by each little square is $\frac{1}{100}$ of 20,449 square miles; or about 204½ square miles.

(3) Count the number of these little squares occupied by Ireland. Approximately there are 160 of them. Therefore, the area of Ireland is roughly 160 × 204½ = 32,720 square miles. Actual measurements and calculations by surveyors and others have shown that the exact area of Ireland is 32,531 square miles.

(4) Similarly, if we count the little squares covering Great Britain, we shall find that its area is about 88,000 square miles; England and Wales occupying, roughly, 58,000 square miles; and Scotland, nearly 30,000 square miles.

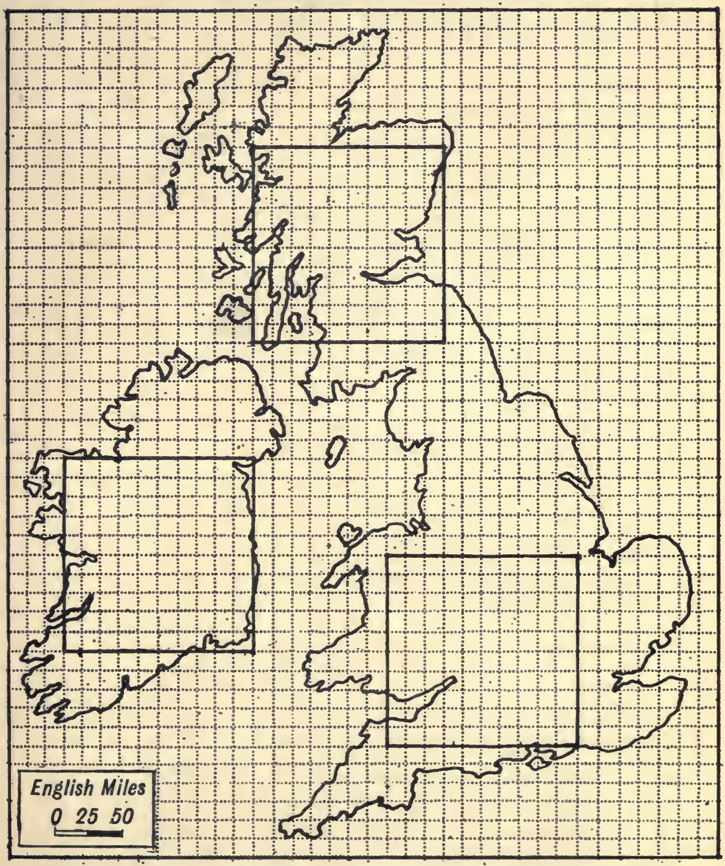
2. TOPOGRAPHICAL MAPS.

1. In the Franco-German war of 1870 the officers of the French army, it is said, were well provided with detailed maps of Germany, but they had none of their own country. As they did not reach Germany, except as prisoners, their maps were not of much use to them. Through their ignorance of their own country, they lost their way on the French roads, with which the Germans were well acquainted from the admirable maps of France in their possession.

2. Boy or girl scouts, cyclists, school cadets, and members of our territorial forces, as well as other people, should make themselves well acquainted with the maps of their own country, and particularly with those of their own district. To have a map, however, is one thing; but to be able to **read** it, so as to understand the information it contains, is quite another thing. Scouts, cadets, and others should be able, moreover, not only to "read" maps but to draw them, at first hand, in such a form as others may be able to understand.

MAP OF GREAT BRITAIN

SHEWING AREA.



Each of the 3 large squares = 1 sq. in., representing 20,499 sq. miles.
Each small square = $\frac{1}{100}$ of a sq. inch, representing 205 sq. miles.

3. It is easy enough to copy a map that someone else has drawn; it is a more difficult matter to draw a fairly accurate sketch map of the part of a country one travels through—one that will show, say, the directions of the streams and watercourses; the trend of the hills, valleys, and mountains; their heights and degrees of steepness or ruggedness; the obstacles to be surmounted in crossing them; or whither the roads, railways, and by-paths lead.

4. Now, the physical features of a country or district may be represented on a map in a variety of ways. The relief maps of this series, for instance, give a rough, general idea of the position and appearance of the highlands and valleys, and of the courses of the rivers. Differences of elevation are indicated by differences in the depth of shading.

5. A map that indicates the physical features of a district in great detail, such as (1) the shape of the surface, its height above sea-level, its flatness or degree of unevenness at various heights; (2) its drainage or the character of its streams, rivers, and lakes; and (3) the works of man, such as roads, railways, bridges, fences, towns, etc., is sometimes called a **topographical** map.

1. Contours.

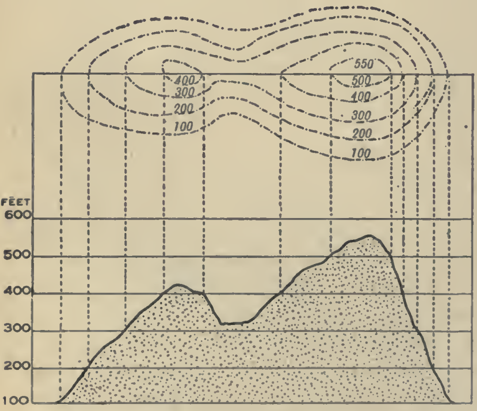
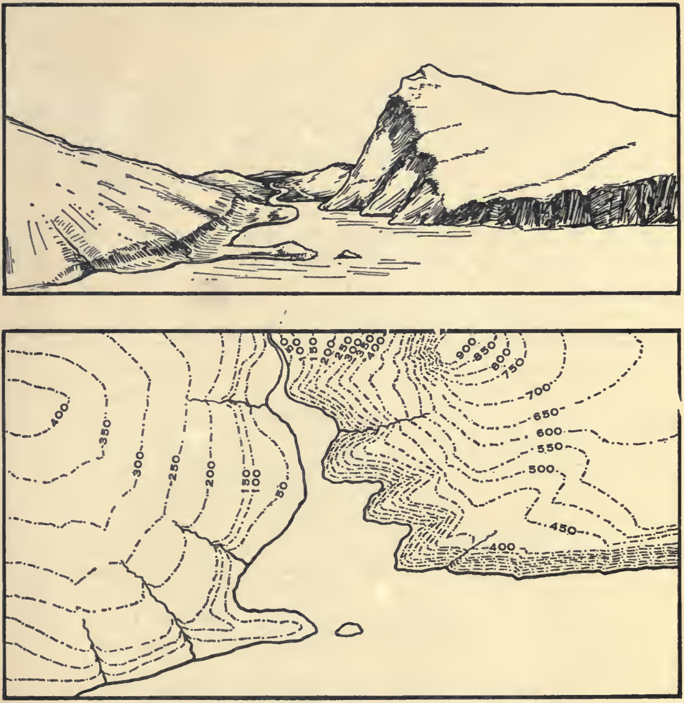


Diagram showing section and contours of a double-peaked hill.

(1) One method of representing inequalities of surface on a map is by drawing lines (called contour lines, or simply contours) through all places that are at the same height above sea level. For instance, if the sea were to rise temporarily 50 feet, the surface of the water would form a plane 50 ft. above its former level, and its margin would trace a line round every hill, and up every valley

within reach. This line would be called the 50 feet contour line.

(2) If the sea were now to rise another 50 feet we should have another line winding round the hills, and up the valleys, representing the surface of a body of water standing 100 feet above ordinary sea-level. This line would be called the 100 feet contour.



Sketch, and contour map of the same place.

(3) Similarly, if the sea were to continue rising by successive stages of 50 feet, covering the plains and rising up the valleys and mountains until the highest point of the land was reached, and were then to recede by similar intervals to ordinary sea level, leaving a mark like high-water mark at each 50 feet interval, we could draw on a map contour-lines indicating these successive levels.

(4) If the land were very steep some of these lines on the map would be close together. When the land had a gentle slope they would be wider apart, and wider apart still where the land was almost flat. On a map, then, the varying distances between the contour lines would indicate the slope or degree of steepness of the land. The vertical distance of each contour line above sea-level would (usually) be marked in feet.

(5) Contour lines, then, may show the forms and the steepness of sloping land. In the first place, as they are continuous horizontal lines at given heights above the sea, they are made to wind smoothly about smooth surfaces. They run up into gorges, ravines or valleys, and project outwards to represent prominences. In the second place, as to rise to a given height on a gentle slope, one must go farther than on a steep one, the contours are shown far apart on the former, and nearer together on the latter, although the vertical distance between each pair is the same.

(6) A comparison of the sketch with the contour map of the same area, given on page 17, will serve to show the manner in which contours express elevation, form, and grade. Note (in the sketch) the sea in the foreground, the river-valley between two hills,—the one on the left rising gradually from the steep river bank, the other on the right rising steeply to a hill 900 ft. high; and see how each of these features is represented on the map by contours, between which the vertical distance, or contour interval, is 50 feet. Note, also, that the steepness of the slope on either side of the valley is proportional to the number of contour lines, and its direction is at right angles to them. The figures denote the vertical distance of each contour above sea-level.

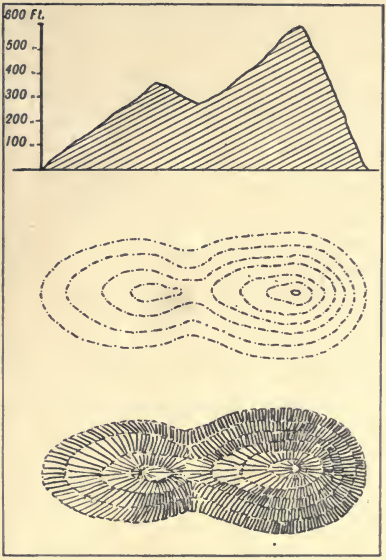
2. Hachures.

(1) Another way of showing differences of elevation is by means of shading lines, or **hachures**. These are drawn directly down the slope of the hills, being made thicker or closer the steeper the ground is; so that the steeper a slope the darker the map in that place. With a gentle slope the hachures are thin and far apart. Flat land has no hachures, whatever be its height. Hence, where the ground is about level, whether in a valley, on a mountain slope, or

on a mountain top, the map is left free of hachure lines and appears white.

(2) In the illustration in the margin the middle figure represents a contour map of a mountain, the contour intervals being 100 feet. In the lower figure the surface of the same mountain is represented by both contour and hachure lines; while the upper figure shows the elevation of a section through the middle of the mountain.

Note that the highest part of the mountain is much nearer the right hand side of the figure than the left, and that the contour lines on the steeper slope are much closer, and the hachure lines much shorter and darker, than where the slope is gentle. The vertical section affords a more forcible illustration of the steepness or gradient of either slope.



Section of hill. Contours, and Contours with Hachures.

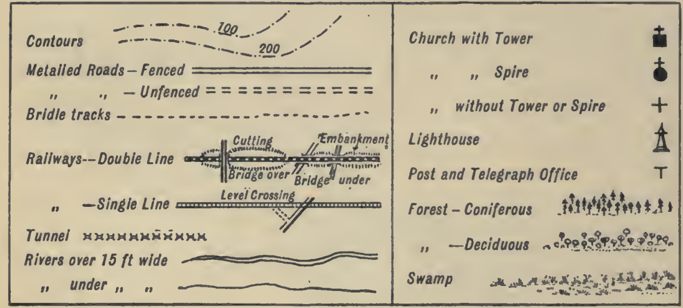
3. MAP-READING.

1. After considering the illustrations given above, and what has been said in reference to them concerning contours and hachures, a person on examining a topographical map should be able to tell which parts of the district represented on it are level or nearly level, as well as the rise or gradient and height of the land in different parts, and the direction of the streams and valleys.

2. Many topographical maps, however, contain

additional information of different kinds, denoted by various symbols which have to be understood and remembered before the maps on which they occur can be read or properly understood.

Thus, the Ordnance Survey Office in England issues a series of maps, on various scales, of different portions of the United Kingdom which anyone wishing to travel through the country may purchase. The series consists of both contour and hachure maps. A few of the more important symbols used in them are as follows:—



(1) The map given opposite is a contour map, drawn to a scale of 2 inches to the mile, in which the contour interval —that is, the difference in vertical height between the contour lines—is 20 feet. As the points of the compass are not marked, the top of the map represents north, the bottom south, and the right and left hands, east and west respectively.

(2) The map may be read as follows:—

The lowest ground is on either bank of the river where the latter begins to widen before entering the sea, the elevation being not more than 20 feet. Towards the south-east the land rises gradually until a height of 160 feet is reached. On the north-east is a cliff, some 20 feet high, surmounted by a lighthouse, from which a bridle-track runs in a south-westerly direction along the right bank of the river to a ford, leading to an unfenced road which joins one of the main (fenced) roads near a township. The latter posseses, besides other buildings, a post and telegraph office, and two churches. From the north-west a railway (double line) leads to the township after passing between a swamp on the north and a deciduous forest on the south, the main road crossing the line by an overbridge. Another railway (single line) from the west passes through the township, skirts a pine forest to the north, and then proceeds through a cutting, a tunnel, and another cutting towards the east.

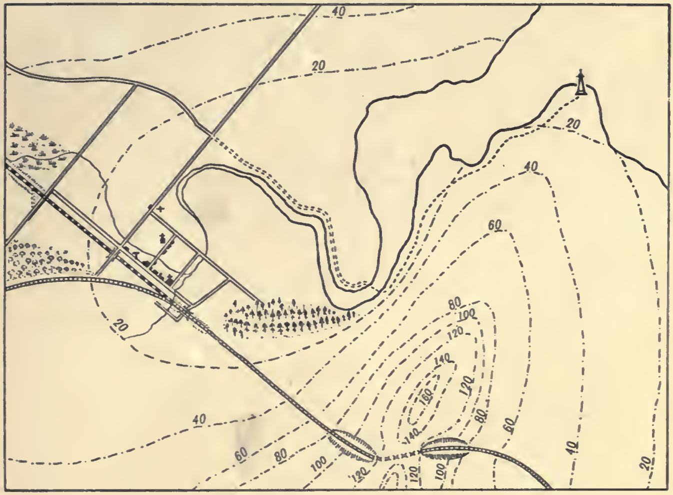
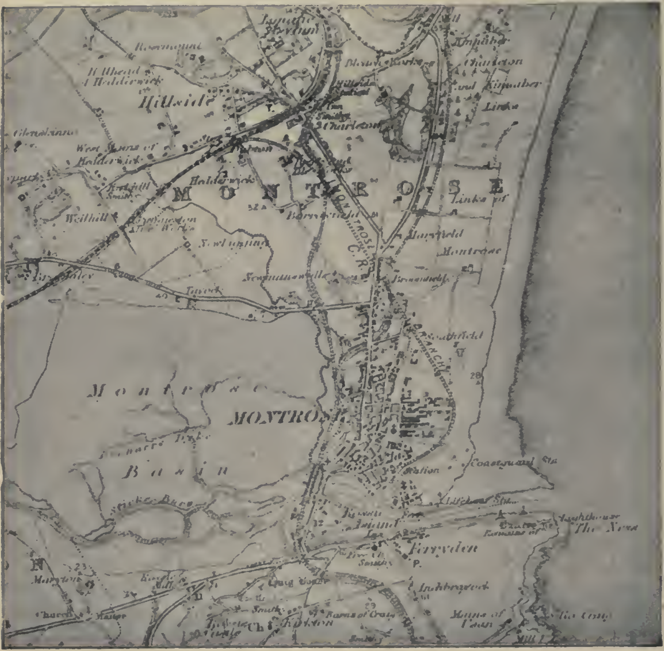


Diagram illustrating use of symbols in map-drawing.
Scale 2 inches = 1 mile.

QUESTIONS, AND EXAMPLES FOR PRACTICE.

(1) From the map measure and calculate the lengths of the fenced roads, the unfenced road, the bridle track, the parts of the railway lines, the tunnel and the cuttings. Estimate the areas of the forest and swamp lands. At what height above sea level are the two forests and the swamp respectively? Measure the greatest width of the river. How far by the nearest road is the post office from the lighthouse?

(2) Draw a sketch showing a piece of ground rising to a hill of 625 feet on the west. On the map indicate, by using the symbols explained above, a main road running near the east side and passing through a wood. Show an unfenced road leading from the main road into another wood on one side. A railway crosses over the main road near the middle to a village on the eastern edge which has a church with a spire. The top of the hill is covered with firs.



(3) Sketch a rough contour map, locating all the principal physical features, roads, railways, prominent buildings, etc., within a radius of 3 miles of your school.

(4) Write out a description of the place given in the above map, stating definitely all the information that the map contains.

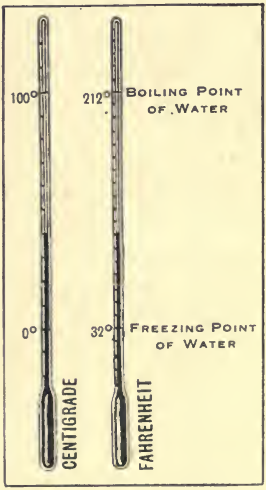
4. SOME EXPERIMENTS WITH ICE, AND WHAT THEY SHOW.

1. Temperature of Melting Ice.

1. Pound a solid block of ice into small pieces and place the bulb of a thermometer in their midst. Suppose that the mercury in the instrument sinks to 20°, that is 12° below freezing point, which, on a Fahrenheit thermometer, is marked 32°. If we now heat the ice by placing a lighted spirit lamp underneath the vessel containing it, its temperature will rise until the mercury column stands at 32°. The mercury will remain stationary at this point as long as there is any ice left, thus showing that the temperature of the water into which the ice is changing is not rising.

2. How is it that the heat from the spirit lamp does not raise the temperature of the water above this point? The reply is that it is engaged in doing other work. It is being used up in changing the ice into water.

3. At first, the effect of the heat applied was to raise the temperature of the cold ice, but when this temperature reached 32° the ice began to melt, and the heat was then wholly employed in melting the ice and not in making warmer the water into which it was turned. This water, therefore, remains at a temperature of 32° as long as there is any unmelted ice in



Centigrade and Fahrenheit Thermometer Scales it. This statement can be expressed in another way by saying that streams from the melting ice keep the water cool, or at the same temperature until the ice is melted. The temperature of the water is then 32°, or the same as that of melting ice. As soon as all the ice is melted the temperature of the water will begin to rise, and will go on rising until the water boils.

2. Latent Heat.

1. As the spirit lamp has been burning all the time the ice has been melting, a great deal of heat has been produced. This heat, as we have seen, has been employed in changing the ice into water. It is absorbed by the melting ice and remains latent or hidden in the water into which the ice is changed. It does not affect the thermometer because it is doing other work, that of changing the ice into water.

2. Ice, therefore, at 32° F., in the act of changing into water at 32° F., absorbs a quantity of heat from its surroundings; and this heat, known as **latent heat** (because it cannot be detected by a thermometer, or by touch) is retained by the water produced.

Another way of expressing this is to say that ice at 32°F. is equivalent to water at 32° F. together with a large amount of latent heat.

3. Similarly, if we were to pack some freezing mixture* round a glass jar containing some of this water at 32°, ice would immediately begin to form on the water; but the thermometer would show that the temperature would not fall until the whole of the water was changed into ice. The reason for this is that the freezing mixture is absorbing heat from the water. It continues to do so until all the latent heat

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*Ice or snow, and salt, mixed together, form a mixture colder than either constituent.

has been absorbed, whereupon the water assumes a solid state.

3. Ice Formed by Rapid Evaporation of Water.

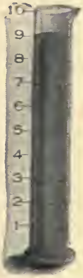
1. A liquid that on exposure to the air changes very quickly into vapour or gas may become very cold in doing so, because in order to make this change of state it requires a great deal of heat, and gets it where it can. Thus, if some ether be dropped on the hand, the latter becomes very cold, for the reason that the ether changes very quickly into vapour owing to the heat supplied to it by the hand. The hand is robbed of some of its heat, and the sensation of cold is experienced at the spot where the ether rested on it.

2. Even if the hand be dipped into cold water and then exposed to the air, the moisture on the hand soon evaporates, and for a similar reason the hand feels cooler than before.

That coldness, or loss of heat, is produced by liquids changing rapidly into vapour may be also shown in this simple way. Pour some ether into a shallow glass dish resting on a few drops of water on a table. Blow into the ether, which will evaporate leaving the dish frozen to the table.

4. Expansion of Water when Freezing.

Procure a glass vessel, like that shown in the margin, and let its height be similarly divided into 10 equal parts.* Pour into it fresh ice-cold water until the water is level with the figure 9. Now stand the vessel in a freezing mixture until the water is frozen. When this takes place it will be noticed that the former column of water, 9 divisions high, has been changed into a column of ice 10 divisions high. In other words the solid



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*Say, by a strip of paper so divided and then gummed on.

water, or ice, expanded until it occupied $1\frac{1}{9}$ times as much space as did the liquid from which it was derived. The bulk or volume of the column has thus been increased by one-ninth.

5. Volume and Density of Ice Compared with those of Water.

1. In the last experiment, if we had weighed the glass vessel along with the column of water in it, and had then weighed it again after the water had been changed into ice, we should have found that the weight in each case was exactly the same. As the weight of the glass vessel was of course the same in each case, it follows that the water was of exactly the same **weight** as the ice into which it was expanded. That is to say, the piece of ice mentioned weighs the same as a smaller piece of water; or ice is lighter than water.

2. To show this in another way. Chip off the ice between the 9th and 10th divisions (see last experiment) evenly all round, and we shall have a piece of ice of exactly the same size or bulk as the original column of water. Now weigh the ice and the original bulk of water respectively, and we shall find that the ice weighs less than the water. This shows that bulk for bulk, ice is lighter than water. In fact, if we were to weigh a cubic foot of fresh water we should find that it would weigh about 1000 oz.; whereas a cubic foot of ice would weigh about 916 ounces. In other words, the water is about $1\frac{1}{9}$ times as heavy as the ice, or the weight of ice is $\frac{9}{10}$ that of an equal volume of water.

3. Again, if the original column of ice were removed from the vessel, and were placed vertically in a bucket of fresh water, the water would reach up to the 9th division mark. That is, the ice would

float in the water with one-tenth of its surface above water and nine-tenths below water.* If this column of ice were placed in **sea-water,** which is heavier bulk for bulk than fresh water, about one-ninth of its volume would be above the surface of the water. and eight-ninths below it. In each case the weight of the floating body equals the weight of the displaced liquid.

(1) If the top of a floating iceberg, therefore, were 100 feet above the surface of the sea, the part of the iceberg under the water would be 800 feet in length; and the total height of the iceberg would be 900 feet.

(2) The depth to which an iceberg will sink, however, depends to some extent on its shape, as it may have a long, flat base, which will help to buoy it up. Again, glacier ice is not so heavy as river or lake ice, unless loaded down with rock fragments, for it is less compact, its particles not being so closely packed together.

4. We thus see that, when equal volumes of ice and water are compared, the ice weighs less than the water; but, if equal weights of ice and water be considered, the ice occupies more space than the water, the particles of water being more closely packed together than those of ice. In other words, the density of ice is less than that of water. If the density of water be taken as 1, that of ice would be about ·9.

6. Two Surfaces of Ice in Contact Easily Freeze Together.

1. If two slabs or blocks of ice be placed in contact, one above the other, the pressure of the upper block on the lower melts a small portion of the surfaces where they touch each other.† A very thin film of water is thus produced between the two ice-surfaces, which immediately re-freezes through contact with the colder ice, and thus the two separate slabs become one solid block of ice.

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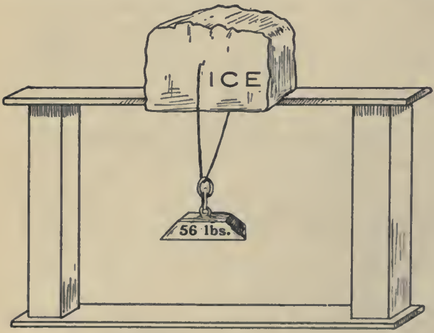
*See page 42.

† Pressure lowers the melting point of the ice to which it is applied.

2. Similarly, if a mould be filled with pounded or powdered ice, and the ice be then heavily pressed into the mould, the result will be a clear block of solid ice having the exact shape of the mould. The grains of ice, through the pressure applied, become partially melted; but contact with the unmelted and colder portions re-freezes the melting ice, thus forming a solid block.

3. If a piece of thin copper wire, with heavy weights hanging freely from either end, be placed across a block of ice, the wire will sink gradually right through the ice and yet the block will remain all in one piece. The explanation is that the pressure of the wire melts the ice in contact with it, causing the wire to sink lower and lower through the block; but as it sinks, the water so formed freezes again and re-unites the portions cut by the descending wire.

4. The property by which ice melts in this way and then re-freezes is called **regelation** (Lat. *re*, again, and *gelatum*, frozen). Most children know that a snowball when squeezed tightly in both hands soon becomes a ball of ice. The pressure of the hands squeezes the particles of snow close together, causing them to melt partially and then re-freeze, or become solid by regelation.



Regelation experiment

It is thought not improbable that regelation, or the melting and re-freezing of portions of a glacier, has much to do with glacier motion.

7. Water when Freezing Expands with Great Force —Fracture of Rocks.

1. Not only does water expand, as we have seen, when freezing, but it also expands suddenly and with great force. To show this, fill a small clear glass bottle with water, leaving barely enough room for the cork. Cork the bottle closely, and wire the cork so that it cannot be easily pushed out by pressure from within. Insert the bottle in a freezing mixture, wholly covering it. The water in the bottle will soon become a solid block of ice, but as the ice must occupy more space than the water did, it will suddenly make room for itself by bursting the bottle into fragments.

2. Similarly, when water enters the pores and cracks of earth-clods or of rocks, and then freezes, it crumbles the earth-clods into fragments, and breaks off pieces of the rock, or rends it asunder, in its effort to make room for itself.

3. Farmers make use of this property of ice when, after ploughing their ground, they leave it fallow in winter so that the frost may crumble the furrows into powder. In a severe frost, water-pipes often burst because they are not strong enough to resist the pressure of the expanding water as it freezes.

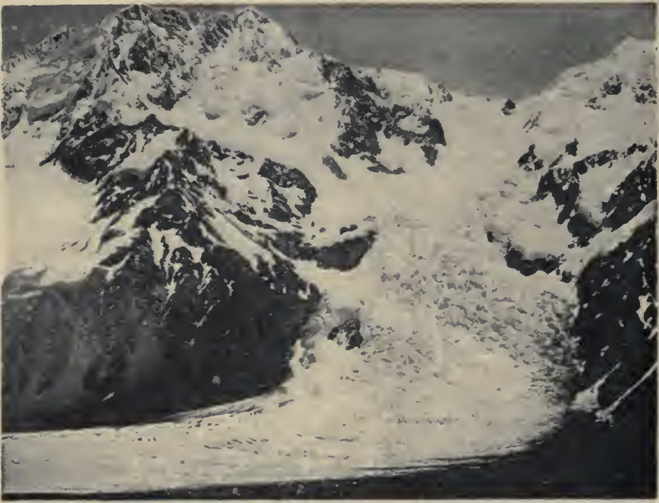
5. GLACIERS AND THE WORK OF ICE.

1. We have now to learn something about the work of ice when it is in motion in the form of glaciers.

1. Glaciers and Rivers.

1. Glaciers have been called "rivers of ice" because they move or "flow" from a higher to a lower level, something after the fashion of a river; and also because they do work somewhat similar to that performed by a river.

2. If, say, the country through which the St. Lawrence River flows were suddenly elevated about seven thousand feet, the intense cold would change the river into a huge glacier. Its tributary streams and rivers would become tributary glaciers; Niagara would be a gigantic **ice-fall**, above which, owing to the severe strain, there would be great cracks and rifts in the ice, called **crevasses**; and the work performed by the new glacier would



N.Z. Govt. Tourist Dept., photo

Mount Cook and the Hochstetter Icefalls (latter one mile wide). Note the many crevasses.

be very similar to that carried on by the present river; only it would be performed very much more slowly.

3. The work of a river, as we have formerly seen, is to collect and carry away the surplus rainfall of the country through which it flows; to transport the remains of decayed rocks from higher to lower levels; to wear away its banks on either side, and hollow out its bed; and to form river-plains along the margins of its course, and deltas or bars at its mouth, with the material it carries down and deposits.

4. Similarly, the work of a glacier is to carry away the **surplus snow** that collects on the mountain tops and in the steep mountain valleys down which it slowly glides; it scoops and hollows out the land beneath it and on either side; it transports to a lower level the rocks, sand and clay it has collected in this way during its progress, or that have fallen upon it from the mountain above, and deposits them along its margin or at its lower end.

5. A glacier, too, like a river, for the reasons mentioned later on, flows more quickly near the surface and at the middle than at the sides or bottom. It may also have tributary glaciers flowing into it, as shown in the picture on page 32, just as a river may be fed by tributary streams.

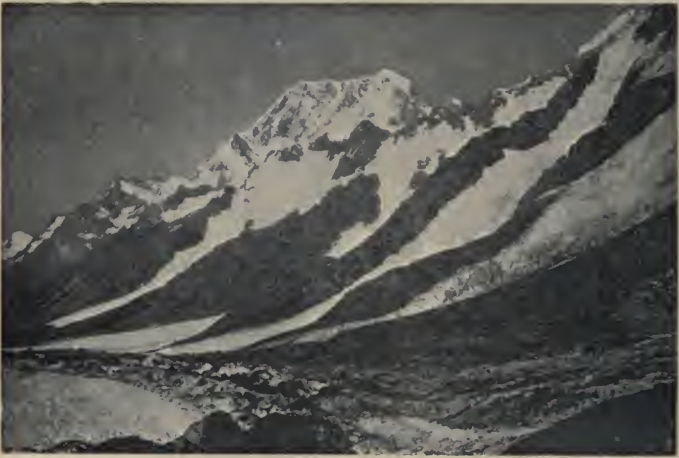
2. Valley Glaciers.

1. In the Southern Alps the snow-line is about 6,500 feet above sea-level. Above this line is a vast snow-field where snow accumulates, year after year, in places to depths of hundreds of feet.

2. Some of the surface snow is melted by the heat of summer suns; storms of wind whirl some of it

into the valleys below; while some of it slips down the steeper faces. Altogether, so much of the snow finds its way into the valleys, in the form both of slides, great and small, and of avalanches, that they would soon be completely filled up if the motion of the snow-mass were not continued downwards.

3. As the snow-mass gradually slides down into the valleys, and continues its movement along them, its particles are pressed and crushed together to such an extent that the snow changes from a soft spongy substance into a hard grain-like material, called "granular snow-ice," somewhat similar to the snow lying by the road-side after frost has hardened it.



Muir & Moodie photo

Tributaries of the Tasman Glacier on the Main Divide to the north of Mount Cook. Reading from left to right these are the Freshfield, the Haast, the Kaufmann, the Boss, and the Rudolph. (Note the huge medial moraine formed by the uniting of the Tasman and Rudolph Glaciers.)

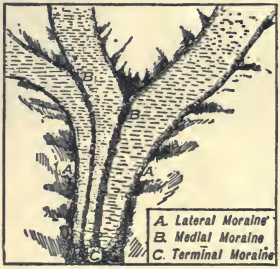
4. As the mass continues its movement down-

wards, its particles become still more closely packed together; more of its surface melts and again freezes, until the mass is gradually changed into pure, clear ice. The pressure of the snow behind, aided by gravity, forces it further down the valley; and the tongue of ice, thus forcing its way downwards, is a valley glacier.

5. Ice being plastic, something like wax, but in a smaller degree, the glacier moulds itself to the shape of the valley down which it flows, fills up inlets and bays, flows round sharp or rounded bends, and, in a general way, behaves itself like a slow-flowing river.

3. Moraines.

1. As a glacier moves down a steep valley, fragments of rock collect on either side; some of which have fallen from the cliffs above, while others have been dragged from the banks during the progress of the glacier. These collections of rock fragments on either side are known as **lateral moraines.**



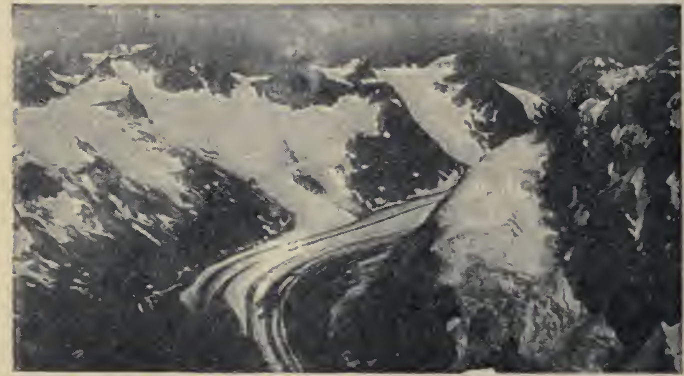
Different kinds of Moraines.

Where a tributary glacier joins the main ice-stream, the adjoining lateral moraines unite, forming a **medial moraine** towards the middle of the glacier.

2. The rocks and other material forming moraines protect the ice-surface on which they rest from the heat of the sun; but the surfaces on either side are constantly being lowered through melting. The consequence is that these fragments of rocks form

ridges on the surface of the glacier which are often several feet high.

3. A **ground moraine** is found on the under surface of a glacier, and consists of the rock-fragments and other materials which the glacier during its downward course has scooped out of its valley bed. These rock-fragments, being pressed down by the immense weight of the glacier above, and being partially but firmly embedded in the ice, become scratched, grooved, or scoriated as they are rubbed and grated against other rocks underneath, which in their turn also become marked or scoriated in a similar manner. The rocks at the sides, too, become similarly scratched and furrowed as the glacier moves onward.



Burton Bros., photo

Mueller Glacier from the summit of the Footstool, showing glacier valley, tributary glaciers, lateral and medial moraines.

Prof Park, photo

A stone striated (or scratched) by glacial action

From the scratchings or striations on the rocks of valleys where now there are no glaciers, we can infer that glaciers helped to hollow out the valleys. Similarly, a deeply scratched or furrowed pebble or larger fragment of rock, found, perhaps on the plains below, shows that it was once subjected to glacier action.

4. When the foot of a glacier reaches a sufficiently warm region, it melts into streams of water, forming a river. The rock fragments forming the moraines are successively deposited, and sometimes block up the mouth of the valley, where a lake, such as Lake Pukaki, may be formed.

5. The heap of rock-fragments deposited by a glacier at its foot is called a **terminal moraine.**

4. Crevasses.

1. Where the valley bottom along which a glacier moves is very uneven, having, say, steep faces here and there, the glacier is subjected to a severe strain, and often, as a consequence, cracks in places into wide and deep rifts or **crevasses.** These are also formed where a glacier turns a corner. If the face over which a portion of the glacier is passing has a long steep slope, the ice on the surface often becomes so steep, irregular, and broken into crevasses as to be almost impassable. A broken, irregular, steeply-sloping surface of this kind is called an **ice-fall.***

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*See page 30

2. Crevasses are often hundreds of feet deep. Water from the melting surface-ice flows down their sides, and, hollowing out ice-tunnels on the under surface of the glacier, finds its way along the rocky floor, in milky or discoloured streams, to the melting foot of the glacier.

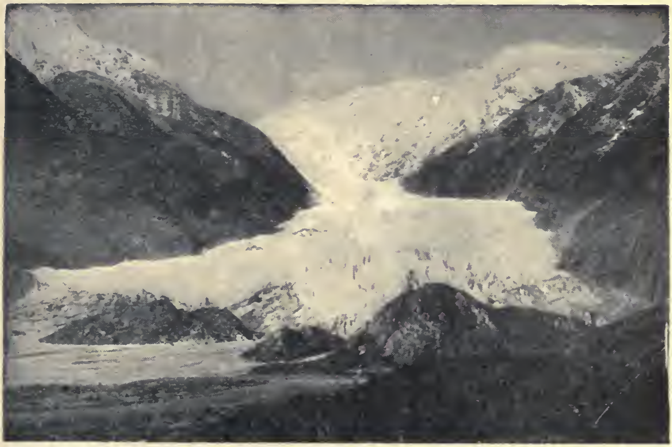
N.Z. Govt. Tourist Dept., photo

Looking into a Crevasse on the Tasman Glacier.

3. The streams of water that flow from the melting glacier foot are generally of a milky appearance, owing to the rock-sediment which the grinding of the glacier has powdered into "rock-flour."

4. A glacier, like a river, flows more quickly near the middle than at the sides; and on its surface, than at the bottom; the reason being that its sides and

bottom are retarded by friction with the rocks and stones of the glacier valley. Owing, therefore, to the middle moving more quickly than the sides, the ice occasionally cracks near the latter, causing "margin crevasses."



Dr. Teichelmann, photo

Comprehensive view of the Franz Josef Glacier including terminal face and moraine from which flows the Waiho river. The dark humps in the foreground are roches moutonnées (or sheep rocks) rounded off by the glacier when in times past it used to descend low enough to cover them.

5. Work of Glaciers.

1. The work performed by glaciers in wearing down the rocks, and in widening and deepening valleys, is known as glacial erosion.* Glaciers also, as we have just seen, carry down with them huge rocks, smaller stones, and other material, and deposit the bulk of such material at their lower or melting ends, where, in each case, a terminal

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*The deepening process is sometimes called *corrosion*, while the widening process is referred to as *erosion*.

moraine is formed, through which streams from the melting ice flow, forming the source of a river.

(1) The formation of the West Coast Sounds of Otago is thought by some to be due to the eroding work of glaciers.

(2) Terminal moraines, by blocking up the valleys down which the ice-streams once flowed, have helped to form such lakes as Coleridge, Pukaki, and Tekapo; while Te Anau and Manapouri seem to have been partially formed in this way.

(3) The rocky sides and bottoms of many valleys have been rounded, smoothed and made U-shaped by the work of former glaciers.

(4) The "rock-flour" caused by the grinding of the glacier over its bed, and carried through waterworn ice tunnels underneath the glacier to the river springing from its melting face, helps to form and enrich the plains below.

6. A Glacier's Rate of Flow.

1. Owing to the slow rate at which a glacier moves, it is more difficult, and takes a much longer time, to estimate its speed accurately, than it would to ascertain the rate of a river. The Tasman Glacier, for instance, has an average width of about 1¼ miles, and moves downwards at the daily rate of about 5 inches at the sides and 18 inches at the middle. If, therefore, a row of stakes were placed right across it in a straight line from bank to bank, the end stakes being stationary on the banks, and the row of stakes were examined again in, say, three months' time, the middle ones would be seen to have advanced about 45 yards.

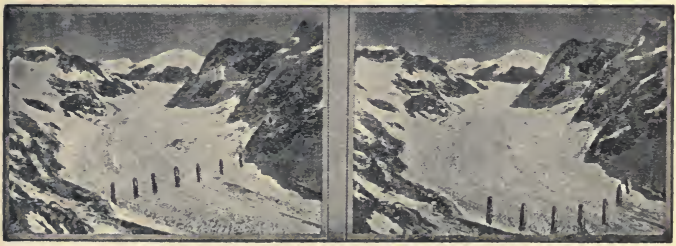
7. Distribution of Glaciers.

1. Glaciers occur in very many different parts of the world, and even in tropical countries. In warm

climates they are found only in the upper valleys of very high mountains. In colder climates they occupy lower mountain valleys; and in the Arctic and Antarctic regions they descend to sea-level.

(1) In some of the high mountain valleys of Mexico and Peru, both tropical countries, small glaciers are found.

(2) In Switzerland there are hundreds of valley glaciers, most of which are annually visited by streams of tourists. Many glaciers occur also in the Caucasus and Himalaya mountains; in Norway some of them descend to sea-level. In western United States, and especially further north in Western Canada and Alaska, glaciers are exceedingly numerous and large.



Measuring a glacier's rate of flow by means of a line of stakes.

(3) The **Muir Glacier** of Alaska ends in a sea-cliff of ice 200 feet high, extending below the water for 700 or 800 feet more. Small icebergs frequently break off from its face, and float about the bay, which is regularly visited by steamers.

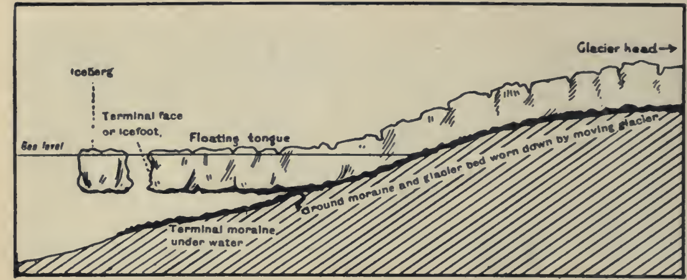
(4) Glaciers are numerous and of great size in Arctic and Antarctic regions also, where they descend to sea-level and produce icebergs in the manner illustrated on page 40.

8. New Zealand Glaciers.

1. In New Zealand, glaciers are larger and more numerous in the South Island than in the North Island. This is due, in the first place, to the fact

that the mountains of the former, particularly the peaks of the Southern Alps, are in general higher than those of the North Island; and, in the second place, to the southerly position of the South Island; that is, to its greater distance from the equator.

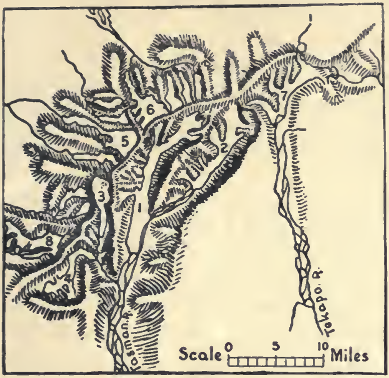
2. In the **North Island** the snow-line is between 7,000 and 8,000 feet above sea-level, while in the South Island it is a little below this limit. While Ngauruhoe and Egmont, which are well above 7,000 feet high, are snow-capped all the year round, **Ruapehu**, which is 9,000 feet high, is the only mountain of the North Island permanently flanked by valley glaciers. Even these, however, are small and of secondary importance, hanging, as it were, in the depressions or valleys; for which reason they are called **hanging glaciers.**



How icebergs are formed.

3. In the **South Island**, the glaciers of the Southern Alps are on a much grander scale, some of them being amongst the largest of the temperate regions of the world. Quite a number of the mountain peaks of this Alpine region exceed 10,000 feet in height. Mt. Cook, the centre of the main

glacier system of the Southern Alps is over 12,000 feet high.



Prof. Marshall

Map of Mount Cook Glaciers.

1. Tasman.
2. Murchison.
3. Hooker.
4. Mueller.
5. Fox.
6. Franz Josef.
7. Godley.
8. Douglas.

4. The western slopes of the Southern Alps face the prevailing moisture-laden winds from the Tasman Sea, and are on the whole much steeper than the eastern slopes. The snow-fall is therefore heavier; and the glaciers are more numerous than on the opposite side. Owing to the general steepness of the slopes, they flow more rapidly, are rougher and more deeply broken with crevasses, and reach a lower level than the eastern glaciers.

The largest of the western glaciers are the **Fox** glacier, with a length of 9¾ miles, and the **Franz Josef** glacier, 8½ miles long. The flow of the latter is about 2 feet a day, while its terminal face is less than 700 feet above sea-level, the seaward end of the Fox glacier being somewhat lower.

5. The eastern slopes of the Southern Alps are drier and less steep than the western slopes. As a consequence, although less snow falls on the former, it takes longer to disappear; and therefore the glaciers are larger and move more slowly, but do not reach so far down the mountain sides as those on the western.

6. The largest and best known of the eastern

glaciers of the **Mt. Cook** region are the **Tasman, Murchison, Hooker,** and **Godley** glaciers.

EXPERIMENTAL HINTS.

In many New Zealand schools, in winter-time, snow and ice may generally be obtained, and experiments with ice, therefore, may be readily made to illustrate glacial phenomena, *e.g.*:—

(1) Procure as thick a block of ice as is conveniently possible, and float it in fresh water. Carefully measure the height of the portions above and below water respectively, and ascertain the fraction one is of the other and of the whole piece. It will be found that $\frac{1}{9}$ of the height will be above the surface of the water and $\frac{8}{9}$ below it.* If possible, repeat the experiment using sea-water. Show how inferences may be drawn as to which is the heavier—fresh water or sea water?

(2) From the measurements referred to in the last paragraph, and the proportions obtained, work a few simple problems relating thereto, such as: Given the top of an iceberg to be 200 feet above the water, what is the total height of the mass? In what depth of water would the berg be aground? etc.

(3) Show how to make a freezing mixture with ice and salt, and its use. On bottom of box with removable ends place a sheet of ice. Next to one end place thin layers of snow with intervening layers of mixed gravel, sand, and clay, leaving other end of ice-sheet clear, and somewhat the lower. Press layers together as closely as possible, and allow mixture to freeze, either by use of freezing mixture or by exposure. Take away removable ends of box; allow the ice to melt from the top, and note result:—Where does moraine form? Why does surface of lower ice finally become covered with sand?

(4) Lay a thick sheet of ice (to represent glacier) on a slightly sloping, and finely grooved board, the fine grooves being intended to show water-tunnels underneath the glacier. Cut crevasses across and along the ice. Sprinkle ice-surface with sand, gravel, and powdered clay. Slowly pour water on ice-surface to wash sand, etc., into crevasses. Note the streams of water issuing from lower end of glacier, and the

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*See page 27

deposits they make on an almost level surface; or the way their deposits fill up temporary lakes along margin, making plains.

(5) Encourage search for and examination of glacier-scratched or rounded pebbles, or glacier marks on exposed rock-beds, or cliffs. In what direction do the scratches run? Are there any traces of old moraines near the school?

6. WORK OF ICE AND SNOW IN SHAPING THE SURFACE OF THE LAND.

1. Crumbling of the Land.

1. One of our previous experiments has shown that water when freezing expands suddenly with great force, and therefore that when water enters the pores and cracks of the earth and then freezes, the particles in freezing push one another apart in all directions with such force that clods of earth crumble into fragments, and even the strongest rock is sooner or later burst asunder. Fragments of stone, often of large size, are thus broken off from a rock or cliff, and tumble down at the next thaw; just as cakes of cement peel off a plastered wall after a hard frost. Under repeated frosts, assisted by rain and rivers, the strongest rocks may be reduced to powder.

2. Frost is thus a more rapid agent in altering the shape of the land, particularly rocky land, than rain is. Bare faces of hard rock may be exposed year after year to the action of rain without any marked change being visible on their surface; for, unless some of the material of which the rock is composed is soluble in water, the rain will eat its way into the heart of the rock only with great slowness. But when frost comes to the assistance of the rain, the changes in the condition of the stone

are much more apparent. Cliffs are broken down, scattered rocks are crumbled, and the fragments thus produced are in time rendered small enough to be gradually carried away by running water.

W. A. Kennedy, photo

Castlehill Rocks, West Coast Road, Canterbury, illustrating the weathering of limestone rocks (which were formed beneath the sea), chiefly by the agency of carbonic acid gas in the atmosphere, and in rain water.

3. Winter after winter this process is repeated, until eventually the whole face of a country is changed. Besides this, the moisture immediately below the surface also freezes; so that, in cold

climates especially, the ground is frozen hard often to a depth of several feet. The water as it freezes helps to loosen and crumble the subsoil. Sometimes it works up stones and boulders to the surface of cultivated fields, and even displaces fencing or stone walls if they do not penetrate through the frozen surface. The frozen soil also retards the erosive action of wind and water.

2. Affecting the Shores of Lakes and Rivers.

1. The water of a **lake** is generally shallow near the shores. When it freezes, the sand, gravel, and pieces of rock round the borders, or at the bottom, become embedded in the ice. If the temperature rises a little, the frozen surface expands and the edges carry these materials shoreward. When the ice melts, low ridges of sand and gravel, sometimes three or four feet high, may be thus formed in a single winter. Stones and boulders, pushed up by the ice year after year, will make a kind of wall at different places on the margin of the lake. Sometimes, too, the ice is thrust forward under the soil to such an extent as to uproot trees.

2. When the temperature falls, say from 25° to 20° Fahr., the ice contracts, as most solid bodies do on cooling. The ice then pulls away from the shore, taking with it the sand, gravel, and other fragments of rock embedded in it. On the melting of the ice some of these rock-fragments are deposited in the waters of the lake round the margin, thus helping to make the water shallower.

3. In time, therefore, the process being repeated winter after winter, both the expansion and contraction of the bordering ice help to raise the shores and bed of the lake, and thus to make its surface smaller.

4. In cold climates, too, rivers become frozen over, and, on the breaking up of the ice in the spring, some of the gravel and stones on the banks are torn from their beds, and, with the ice in which they are embedded, are floated miles down the stream and deposited as the ice melts.

5. On the banks of lakes and rivers the moisture in the soil sometimes becomes frozen in winter; and this, as we have seen, tends to crumble the soil into smaller fragments. When thawed, some of these smaller fragments are washed by the rains into the waters of the lake or river, and are deposited there, or are carried further down the stream by the river and then deposited. In either case the action of frost helps to crumble away and again build up the banks and bed of the river or lake.

3. Affecting Coasts—Sea Ice.

1. Fresh water, as we have seen, freezes at a temperature of 32°.; but sea-water does not freeze above from 28° to 26° F. It is only in Arctic and Antarctic regions, therefore, or in northern seas, such as the Baltic, whose waters are freshened by large inflowing rivers, that the surface of the sea becomes frozen. In high latitudes ice forms on shallow sea-waters, and in polar regions it becomes several feet thick, not only along the shores but on the open sea also.*

2. The work performed by coastal sea-ice is somewhat similar to that of lake and river ice, in that when the ice is breaking up, sand, gravel, stones, and boulders are torn from their shore-beds and deposited in the sea when the ice melts; thus helping

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*This sea-ice is fresh, as the salt and other mineral particles do not freeze.

to wear away the land, and build it up again by making the shore-water shallower.

3. When the sea freezes along the coasts, as in Greenland and Antarctica, a cake of ice is formed which, rising with the tide, is frozen fast to the shore. Thus, gradually, a sheet of ice known as the ice-foot forms along the shore, often reaching a height of from 20 to 30 feet above the level of the floating ice. Great quantities of earth and stones, broken off from the cliffs by the severe polar frosts, fall upon the ice-foot; so that, in time, its surface becomes covered in places by sand, gravel, and other rock fragments. When summer comes, and the ice-foot partially melts, some of this waste is deposited along the sea-margin, thus forming a gradually rising rock-shelf. Some of it, also, is carried out to sea by tides or currents, with the fragments of broken ice.

7. EFFECTS OF GLACIAL ACTION ON CULTIVATION AND SETTLEMENT.

1. In the past, when valleys were scooped out by descending glaciers, some of the *débris* was deposited by the melting glaciers on the more gentle slopes, while some of it was left at the glacier foot. In either case the material was further crumbled by the action of the weather, and more widely distributed by running water.

2. Thus, in parts, soil was formed and left which made cultivation and the settlement of a farming population possible. The soil of the plains, too, (themselves formed partly by the result of glacier action) was also improved by the crumbling fragments brought down by the glacier.

3. By sculpturing valleys, and planing down hills and rocks, the ice left the surface of the land smoother than before, and thus made it easier for roads and railways to be made. Glacial action has, therefore, helped to make travel and transport easier.

4. The waterfalls, rapids, and lakes that have been formed or made possible partly by glacial action have added to the water-power of some countries. Glacier-formed lakes, in particular, tend to make the streams flow with greater regularity throughout the year than those which have no such reservoirs to draw from.

Prof. Park, photo

Terraces or steps on slopes of Ben More (Wakatipu district) cut by ancient glacier action.

5. In some places the effect of glacial action has not been beneficial, as it has injured the soil by a deposit of drift too stony, sandy, or gravelly to be of any use for cultivation.

6. Of course where glaciers are in actual existence neither cultivation of the soil nor settlement is possible.

8. ICEBERGS.

When a glacier enters the sea, as many in the Arctic and Antarctic do, the water buoys the end of the glacier up, and the severe strain resulting causes great masses of ice to break off in the sea. These floating masses are called **icebergs**.

Mount Cook (Aorangi) from the Hooker Valley.

Currents carry them away into the open sea, often to warmer climates, where they speedily melt, depositing in the ocean stones, gravel, and other matter which they collected while they formed part of the glacier.

(1) The Banks of Newfoundland, off the east coast of North America, where the great cod-fisheries are, have been formed in this way. When the icebergs, brought down by

the cold polar current that washes the eastern coast of Labrador, meet the warm waters of the Gulf Stream flowing northwards, they speedily melt, and deposit their *débris* on the bottom of the Atlantic. As this process has been going on for thousands of years, and the deposits increase year after year, the water over the Grand Banks is slowly becoming shallower.

(2) Melting ice-bergs are the main cause of the fogs which make this part of the Atlantic so dangerous to shipping.

An Antarctic Iceberg.

(3) Icebergs are very numerous in the Antarctic seas, and are not uncommonly met with in the Southern Ocean to the south of New Zealand.

(4) Many icebergs are of vast extent, and tower above the surface of the sea for 100 feet or more in the Arctic Ocean, and 500 feet or more in the Antarctic Ocean. As only one-ninth of an iceberg is above the water, and the remaining eight-ninths are below the surface, the total height may be easily reckoned.

9. PRESSURE OF THE ATMOSPHERE.

1. Air Pressure.

1. Take a long glass tube, closed at one end with a tightly fitting cork that can be readily removed, and open at the other end. Fill it with coloured water, and having closed the open end with the

finger, invert it in a basin of water, and remove the finger. The open end will now be underneath the surface of the water, and the upright tube will remain full of water. Why? The pressure of the outside air on the water in the basin is continued through the liquid to the open end of the tube, and thus prevents the upright column of water from flowing back into the bowl.

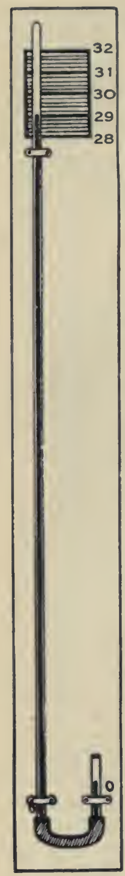
2. The pressure of the atmosphere, therefore, must be either equal to, or greater than, the weight of the column of water in the tube that is above the surface of the water in the basin, because it supports this column.

If the cork were removed from the closed end, the pressure of the atmosphere there would cause the water in the tube to sink into the basin and spread out until the two surfaces had the same level.

3. Numerous experiments have shown that the pressure of the atmosphere at sea-level will support a vertical column of water about 34 feet high, in a tube constructed and filled in the manner described in paragraph 1.

(1) A cubic foot of fresh water, at an ordinary temperature, weighs about 1000 ozs., or 62½ lbs.; and a column of water 34 feet high, in a tube the base of which is 1 square inch, contains about 408 cubic inches, or $\frac{408}{1728}$ cubic feet. It will therefore weigh $\frac{408}{1728} \times 62\frac{1}{2}$lbs., or nearly 15 lbs. As the pressure of the atmosphere against the base supports a column of water of this weight and shape, and as the air (at the same time and place) presses equally on every unit of surface, its pressure at sea-level is therefore about 15 lbs. on every square inch of surface.

(2) As the liquid metal mercury is about 13½ times as heavy as an equal volume of water, it can readily be calculated that a column of mercury, 30 inches high, in a tube whose base is 1 square inch, weighs about



Mercurial barometer.

the same as a column of water 34 feet high of similar base area—that is to say, about 15 lbs.

If, therefore, we use mercury instead of water in our last experiment, we shall find that the pressure of the air balances or supports a column of mercury of about 30 inches in vertical height. In other words, we shall find as before that the pressure of the atmosphere is about 15 lbs. to the square inch.

4. An instrument used to measure the weight or pressure of the atmosphere at any given place is called a **barometer** (*baros* = weight; *metron* = a measure). The column of air above, say, a penny, at sea-level is longer and therefore heavier than that above a similar coin on a mountain top. The different heights of the mercury column of a barometer in either place would show this. Barometers are therefore often used to measure the height of mountains ascended.

2. High and Low Pressures.

1. The mercury column of a barometer varies in height from day to day, and often even from hour to hour, because the weight or pressure of the atmosphere is not always the same at any given place or time. In the Pacific Ocean, for instance, a little to the west of the Californian coast, the average height of the barometer is 30·3 inches; in part of Iceland it is 29·6 inches; while in Antarctica the barometer stands even lower on the average.

2. When the barometer falls below its average height it indicates an area of **low pressure**; but when it rises above its average height it marks a high

pressure area. Roughly speaking, we may say that the usual height of the barometer at sea-level is 30 inches, and any reading below this indicates low pressure, while anything above this denotes high pressure.

3. Apart from elevation changes in the height of the barometric column,—that is, in the pressure of the air,—are chiefly (but not altogether) due to (1) changes in the temperature of the air, and (2) the varying amount of water vapour the air contains.

(1) As air expands when heated, cold air is heavier (because denser) than warm air, so that the latter ascends, while the former descends. When a broad tract of the earth's surface, such as part of Central Asia, becomes greatly heated by the summer sun, the hot air in contact with the ground rises, and flows over into the surrounding regions. The air there is consequently rarer and therefore lighter than in the colder season, and accordingly the atmospheric pressure is lower during the warmer than during the colder months.

(2) Experiments show that water vapour is very much lighter than air that contains little or no water vapour. Accordingly, when the air is **moist**, its pressure will be less, and the barometer will therefore be lower than when the air is **dry**.

When the air is highly charged with water vapour, a lowering of the temperature may condense some of the water-vapour into rain. Hence, a low barometer is popularly held to indicate a probability of rain. The inference, however, is very often quite incorrect, as other circumstances than superabundant water-vapour may cause a low barometer.

4. **High pressure areas** (shown by a high barometer), then, **occur** (1) when the air over a region is cold, because then it is denser than before; (2) when the air is dry, for then it is heavier than when it is moist; and (3) when an upper current of air sets in towards a lower area, for then it compresses the strata underneath.

5. **Low pressure areas** (shown by a low barometer) **occur** (1) when the air near the earth is heated, and is thus made to expand and swell upwards; (2) when the air is moist, because then it is lighter than usual; and (3) when the air from any cause has an upward instead of a downward movement, as in the region of equatorial calms, where the barometer is always low.

10. WINDS.

General Causes.

1. We have already seen that **wind,** or air in motion, is caused mainly by **differences of atmospheric pressure**; and that difference in air-pressure is itself due to differences of **temperature** and **moisture.** In relation to the latter an important factor is the **different rates** at which land and water respectively are warmed and cooled.

2. The **directions** in which the winds blow are due to a variety of causes, among which the most noteworthy are,

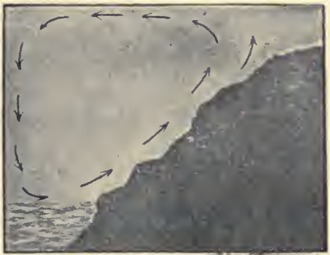
1. The relative positions of high and low pressure areas.
2. The rotation of the earth.
3. The relative positions and forms of land and water areas.

1. **Differences of air pressure** cause the air to move from an area of high pressure to one of low pressure. Dense air, therefore, moves towards the rarer air it displaces. Similarly, both cold air and dry air, on account of their extra density, displace neighbouring warm or moist air. Currents of air are consequently being continually formed owing to differences of pressure caused by differences of temperature and moisture.

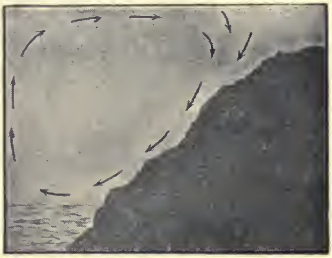
2. **Rotation of the earth.** If the earth did not rotate, the colder and therefore denser air near the poles would

move southward and northward, respectively, toward the heated air near the equator, as northerly and southerly winds. As the earth, however, does rotate, a place on the equator is carried round at the rate of a thousand miles an hour, while other places nearer the poles are carried round at correspondingly slower rates.

The air moves round with the earth; but the northerly and southerly air-currents mentioned, in their journey towards the equator, are constantly passing into latitudes where the earth is moving faster and faster from west to east. In changing their latitude, that is to say, these northerly and southerly air-currents cannot immediately take up the increasing rotatory movement of the earth, but lag behind, thus taking in relation to the surface of a earth, a north-easterly and south-easterly direction—that is to say, they form north-easterly and south-easterly winds.



Sea-breeze during day

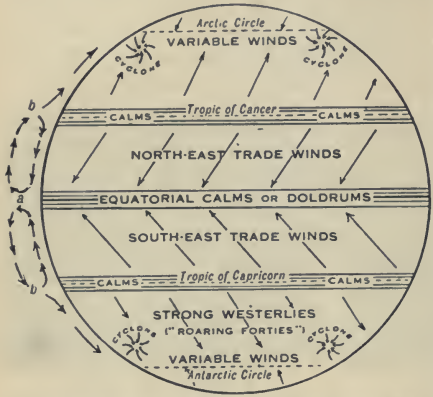


Land-breeze at night.

Anyone, therefore, standing (say) 20° or so north of the equator, with his face towards the east (that is, in the direction towards which the earth is rotating) would feel a current of air moving towards him, blowing on his left cheek. This current of air, that would apparently be coming from the north-east, is generally known as the **north-east trade wind**, as we shall see directly. Similarly, if the person were a little to the south of the equator, with his face still towards the east, he would feel a current of air on his right cheek. This would be the **south-east trade wind.**

3. **Effect of relative positions and forms of land and water areas.**—(1) As the land heats more quickly, and cools more rapidly than the sea, near the sea-shore on a clear

morning until after midday the cooler air over the sea will move towards the land, as it displaces the warmer and therefore rarer and lighter air there. This current of air blowing from the the sea towards the land is known as a sea-breeze. Similarly, towards evening, when the land is parting with its heat more quickly than the sea, the denser and cooler air over the land will tend to displace the warmer and therefore rarer and lighter air over the sea, and will thus move seawards. This current of air blowing from the land towards the sea is known as a **land breeze.**



Prevalent winds of the globe. Note the warm air rising at *a* and descending, when cooled, at *b*.

"During the day the land-surface becomes hotter than the sea-surface, and the air resting upon it rises and flows off above, while the cooler air comes in from the sea as a sea-breeze. As the sun sets, the land surface quickly cools, until it attains the same temperature as the sea, when calm prevails. An hour or two before midnight the land has cooled so rapidly that it is now colder than the sea. The air over it contracts, and its pressure becomes greater than the warmer air over the sea. Hence it is that this heavier air flows from the land to the region of lower pressure over the sea, and a land breeze blows until 6 or 8 o'clock in the morning."

The **trade-winds** are constant winds blowing in a regular trade or course towards the equatorial region of low pressure. Those in the northern hemisphere, starting about 30° north latitude, and being deflected towards their right by the earth's rotation, constitute the north-east trades; and those in the southern hemisphere, starting about 30° south latitude, and being deflected towards their left, constitute the south-east trades. They both die out as they approach the belt of calms.

Beyond the borders of the trade-winds in both hemispheres the prevailing winds are not so regular as the trade-winds. These are westerly winds which arise in great part from the upper currents that flow from the equator, and then descend to the surface about the 30th parallel of latitude (at *b* in diagram opposite) where they produce the **Calms of Cancer** in the northern hemisphere and the **Calms of Capricorn** in the southern. Continuing northward and southward, and being deflected to the right or left (north or south) respectively, by the earth's rotation, they form the Westerlies or anti-trades of temperate latitudes. These westerlies are more regular in the southern hemisphere where there is little land to cause a disturbance, and in the Pacific and Indian Oceans between latitudes 40° and 50° they are so strong and steady as to be called the "Roaring Forties."

(2) The **trade-winds**, mentioned above, would blow regularly all round the earth if they were not interfered with by the positions and forms of the land surface. As it is, they blow with great regularity where there are considerable expanses of ocean; and therefore blow more regularly in the southern hemisphere than in the northern, where there is a greater preponderance of land of different shapes and altitudes.

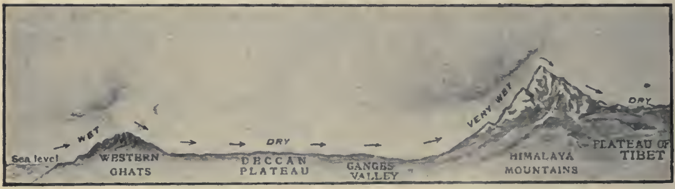
(3) **Monsoons.**—Some lands near the sea become so much heated in the summer that the off-sea wind continues blowing during the whole of the hot season, and not merely throughout the hot part of the day. Similarly, during the whole of the cold season, when the land is colder than the sea, in these regions a from-land wind blows. Such winds, that change their direction with the seasons, are known as **monsoons.**

"The monsoon winds of the Indian Ocean had great influence on the early trade of India. Vessels sailing from Europe used to time their outward voyages so as to take advantage of the south-west monsoon, and their return voyages so as to take advantage of the north-east monsoon."

11. WORK AND INFLUENCE OF WINDS.

The most important work performed by the winds is of two kinds: (1) the distribution of temperature; and (2) the distribution of moisture.

1. **Distribution of temperature.**—A wind blowing from a warm or mild quarter towards a colder region raises the temperature of the place to which it comes. The north-westerly winds of New Zealand, for instance, blowing from heated Australia across the warm waters of the Tasman Sea, make the air of Westland and the Canterbury Plains warmer than it would otherwise be. On the other hand, a wind blowing from a cold to a warmer region lowers the temperature as it moves along. Hence the southerly winds of New Zealand, blowing across the cold waters of the Southern Ocean, tend to lower the temperature of the portions of New Zealand affected by them. Again, owing to the vast expanse of cold land in northern Asia during winter, and the high atmospheric pressure there, the outflowing winds are cold.



A section across India in the path of the South-west monsoon.

2. **Distribution of Moisture.**—The winds are the great agents by which the moisture of the atmosphere is distributed over the land. Winds blowing over great tracts of water become charged with moisture, which they carry along with them and condense into rain and snow over the land.

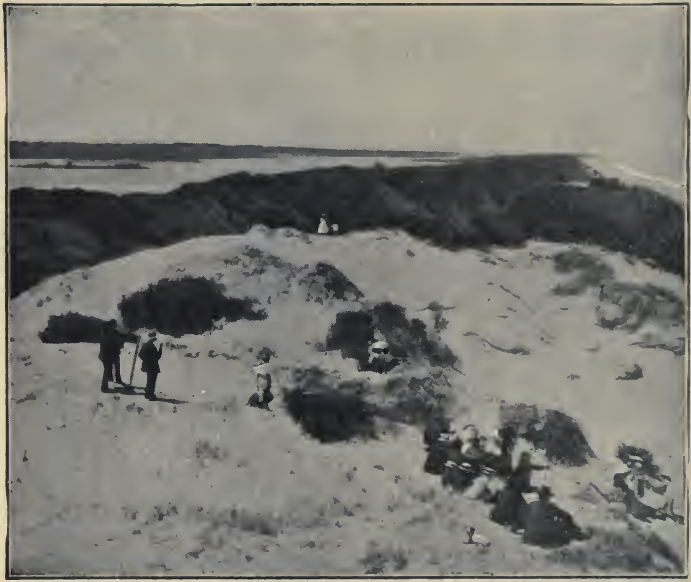
On the other hand, winds blowing across large tracts of land, or high mountains, part with the moisture they have derived from the sea, and become dry winds. Thus, the north-westerly winds of the South Island are moist winds until they shed their moisture on the western slopes of the Southern Alps. Then they blow as dry winds across the Canterbury Plains. The north-east monsoon, too, after crossing the Himalayas, continues as a dry wind across India, while the south-west monsoon,

Underwood & Underwood, photo

An eroded sentinel, Grand Canyon of Arizona, U.S.A. In this almost rainless region, the Colorado River has worn a channel whose banks are over a mile high. The eroding agents here are wind and changes of temperature.

blowing across the same country from the Indian Ocean, is a wet wind.

On the whole, therefore, the temperature, and also the wetness or dryness of any place depend to a very large extent on the direction from which its prevalent winds come. The prevailing winds of a country accordingly have a very great effect on its climate.



Sand hills, Ninety Mile Beach, Victoria.

3. **Other Work.**—Winds also to some extent help to mould the surface of a country. Violent gales not only uproot trees, and do other damage, but they also help to displace rocks loosened by weathering and by running water. Where they cross sandy beaches or deserts, they blow the fine

particles of sand, often with great force, against the cliffs and rocks, and thus help to wear them away. In such places, also, the winds are constantly forming sandhills, and again changing their shapes and positions.

"The shores of the Bay of Biscay furnish striking instances of the power of the winds to alter the surface of a district. The dunes which are there heaped up by the westerly gales march inland at a rate of 60 or 70 feet in a year. No barrier, natural or artificial, is able to withstand their progress. Fields, woods and villages are buried in succession. The sand ridges interrupt the drainage from the interior, and so ponds and lakes are formed, which, unable to find an exit, are driven inland along with the sand barriers which dam them up."

12. RADIATION.

1. How the Air is Heated and Cooled.

1. We know that, as a rule, the air is cooler at night than during the day, and warmer in summer than in winter. Similarly, cloudy days are usually cooler than clear, cloudless days; for the clouds intercept and absorb some of the sun's rays, thus partially preventing them from reaching the surface of the earth. Cloudy nights, on the other hand, as we have already seen, are usually warmer than clear, starry nights; as the clouds prevent the heat the earth has derived from the sun during the day from **radiating**, that is, from being given off into space.

2. As a matter of fact, it is the sun's rays that, penetrating and spreading or diffusing through the atmosphere, in the first place warm the surface of the earth: and it is the land and water surfaces of the earth, heated in this way by the sun, that warm the layers of atmosphere next to them.

3. During the night, the portion of the earth that is turned away from the sun radiates or loses more

of its heat than it did during the day, because the supply of heat from the sun is then temporarily cut off, and the earth thus becomes cool by radiation. We thus see that the sun radiates some of its own heat, and that the earth again radiates the heat it has received from the sun.

(1) A red-hot ball of iron suspended in the air outside soon becomes cool, as it rapidly parts with its heat in all directions. This process is called radiation because the heat waves move outwards, or radiate, from the centre of the ball, as the spokes of a wheel radiate in direction from the hub. The hot ball warms the air in contact with it; and the warm air being expanded, or made lighter, by the heat transferred to it, rises and moves away from the hot ball until in its turn it becomes cool by radiation.

(2) Similarly, the sun is constantly radiating heat. Its rays penetrate and become diffused through the atmosphere without heating it to any very great extent; but they warm the portion of the earth's surface on which they fall. This heated surface warms the air next to it, partly by contact and partly by radiation. The heated air, being lighter and rarer than when it is cool, rises (just as a cork rises in water) because it is pushed upward by the colder and heavier air forcing its way beneath it. This colder air in its turn becomes warmed, and is displaced by other colder air. Consequently, upward, downward, and lateral currents of air are set in motion.

(3) In a chimney, for instance, the fire on the hearth heats and rarefies the air in contact with it. The cooler and denser air near the fireplace crowds in below the expanded air and pushes it up the chimney, causing an upward draught or current of heated air, which will be seen to carry upwards small pieces of paper thrown into it.

(4) Similarly, when the land and water surface of the earth is heated by the absorption of the heat-rays from the sun, the air above the heated surface is also warmed and rarefied, the surface near the equator being more heated than that of more temperate regions. The heated air over this surface expands and rises, until, getting cool as it ascends, it overflows (as it were) and sinks back again, much as an ascending column of water would do.

4. The moisture in the atmosphere absorbs the direct rays from the sun only to a small extent. If there were no water vapour in the air, these heat rays would pass directly to the earth without warming the air. It is the heat rays which are radiated from the sun-warmed earth, however, that are principally absorbed by the water vapour in the air. The moisture in the air, therefore, forms an important agent in keeping up the warmth of the atmosphere.

2. Effect of Long or Short Days and Nights.

1. At any given place, the earth receives more heat from the sun when the days are long than when they are short. This is one reason why the days in summer are generally warmer than those of winter.

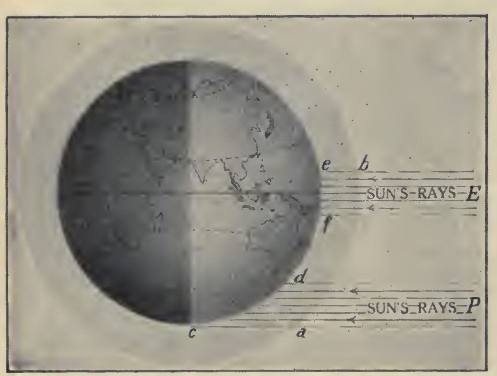
In England, for instance, at London, on mid-summer's day (22nd June) the sun is shining for nearly 17 hours out of the 24; while on mid-winter's day (21st December) it is shining for about 7 hours out of the 24. Similarly in New Zealand, at Wellington, on the longest day (22nd December) the sun is above the horizon for over 15 hours out of the 24, while on the shortest day (21st June) it is shining for nearly 9 hours.

2. During the longest summer days in any place, the earth receives more heat from the sun than it parts with during the much shorter nights; so that the temperature of the air goes on increasing until the loss by night is just equal to the gain by day. At this time, therefore, the greatest heat of the day is usually not until about two hours after noon; and the maximum or greatest temperature of the atmosphere at any place is about a month after mid-summer day—that is, towards the end of July in England, and towards the end of January in New

Zealand. Conversely, the minimum or lowest temperature of the year occurs when the gain by day is equal to the loss by night. This happens about the end of January in England, and about the end of July in New Zealand.

3. Effect of Inclination of the Sun's Rays.

1. If the length of the period of sunshine were all that determined the changes in temperature of the earth's surface, and therefore of the atmosphere, then, at mid-summer, the climate at the Poles would be warmer than that of the Tropics; as at the Poles the sun is above the horizon continuously for six months, while the longest day at the equator lasts for only 12 hours.



Equal groups of rays falling at Equator and at the Pole spread over a greater area at the Pole and also pass through more air. That is, *cd* is greater than *ef*, and *ac* is greater than *be*.

2. But this is not the case, for the heat derived from the sun at any place is greatest when the sun is highest in the heavens, and when, therefore, its rays are more nearly perpendicular to the ground. There are two reasons for this:—

(1) When the sun is higher, its rays pass through less of the earth's atmosphere than when it is lower, and so less heat is absorbed by the atmosphere before the rays reach the ground.

(2) When the sun is higher, the number of rays received by any particular piece of ground is greater than when the

sun is lower—that is, the quantity of heat received by (say) a square yard of ground increases as the sun's altitude increases. This is the chief reason for the increased heating power of the more perpendicular rays, as may be seen from the diagram opposite, which represents the earth surrounded by its atmosphere; the circle passing through *a b* being, as it were, the outer rim of the atmosphere. *E* represents rays from the sun falling perpendicularly at the equator; while *P* represents an equal number of rays falling in a slanting direction near the south pole. The space *cd*, it will be noticed, is much larger than *ef*, while *ac*, the part of the atmosphere through which the *P* rays pass, is much longer than *be*, the part through which the *E* rays pass.

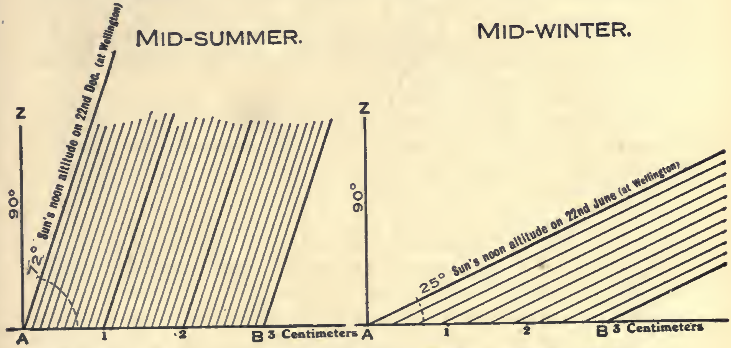

MID-SUMMER.
MID-WINTER.
Z
90°
72°
Sun's noon altitude on 22nd Dec. (at Wellington)
A
1
2
B
3 Centimeters
Z
90°
25°
Sun's noon altitude on 22nd June (at Wellington)
A
1
2
B
3 Centimeters

Diagram showing comparison of heating effects of sun's rays at mid-summer and mid-winter.

(3) A more striking illustration of the difference between the calorific* or heating effects of vertical and oblique rays from the sun falling upon the earth's surface may be seen in the diagrams above, which show the inclination of the sun's rays at Wellington at mid-summer and mid-winter respectively on the same length of ground *AB*. If the sloping lines be taken to represent similar bundles of the sun's rays at equal distances apart, it will be seen that, in the left hand figure, 30 of these bundles warm the space between *A* and *B* on mid-summer day; while, in the right hand figure, only 10 of them warm the same space on mid-winter day. On the latter day, therefore, the piece of ground receives very much less heat from the sun than it does on mid-summer day.

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*From Latin, *calor*, heat, *facio* (*fio*), I make—heat-making.

If the sun's rays were quite vertical, as they are at noon on the 22nd December at the Tropic of Capricorn, there would be still more than 30 bundles of rays falling on *AB*, which would therefore be hotter still on that day.

13. CLIMATE.

1. Weather and Climate.

1. When we speak of the **weather** of a country we mean the changes in temperature, barometric pressure, wind, moisture, sunshine and clouds that occur from day to day. When we are referring to the **climate** of a place, however, we mean the average result of these weather changes extending over a considerable period.

(1) Certain parts of the tropical zone, for instance, are said to have a rainy climate; for the reason that, though the weather on many days is fine, on still more it is rainy. Thus the climate, or the average condition of the weather, is rainy.

(2) Similarly, we speak of dry, hot, desert climates; hot, rainy climates, as in the belt of calms; moist, equable ocean climates; extreme and variable climates, common in the interior of continents; temperate climates; and very cold or frigid climates. New Zealand, for instance, has a temperate and variable climate; for although the extremes of heat and cold are not very great, the alternations of rain, wind, and sunshine are very frequent.

Kinds of Climate.

2. For reasons that will presently appear it is usual to classify climates according to the latitudes in which they occur; that it to say, in the torrid, temperate, or frigid zones. In each of these climatic zones the climate of a place is either (1) **continental**, (2) **insular**, or (3) **oceanic.** If it is surrounded by large tracts of land, as is a place in the interior of a continent, its climate is **continental**; if it is near the sea, as in the

case of places near the coasts of continents, or in moderate-sized islands or peninsulas, such as New Zealand, Great Britain, Japan, or Italy, its climate is **insular**; and if it is a small island surrounded by a vast tract of water, such as the smaller islands of the Pacific, its climate is **oceanic.**

(1) In a **continental climate**, the extremes of heat and cold are very great; that is to say, the climate may be very warm in summer and very cold in winter. The temperature in the day time, too, may be very high, and during the succeeding night be very low. In places situated in the middle of a continent, also, the climate as a rule is dry, while that of elevated places near the sea is usually moist.

The reasons for these differences of temperature and moisture may be readily inferred from previous lessons.

(2) Similarly, the reasons why, in an insular climate, the differences between the temperature of summer and winter, or of night and day, are not very great; and why, in an oceanic climate, they are very slight, will require no further explanation.

As an illustration, we may contrast the mean annual rainfall and range of temperature at Winnipeg in Canada, and Gisborne, N.Z.:—

	Rainfall.	Highest Temp.	Lowest Temp.	Range of Temp.
Winnipeg ..	22in.	68°	–5°	73°
Gisborne	41in.	65°	48°	17°

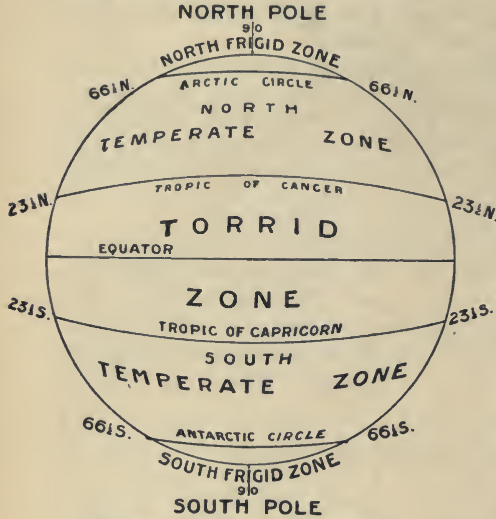
2. Causes of Differences of Climate.

1. The climate of any place depends on several circumstances or influences, the most important of which are:—

(1) Its latitude, or distance from the equator.
(2) Its elevation, or height above sea-level.
(3) Its nearness to or distance from large tracts of land or water.
(4) The temperature and direction of the prevailing winds and ocean currents affecting it.
(5) The direction and slope of its highland and mountain ranges.
(6) The character of its soil and vegetation.

(1) *Influence of Latitude on Climate—Climatic Zones.*

1. We have already seen that when the sun's rays are shining vertically on a portion of the earth's surface they have greater heating power than when they are slanting; for the reasons that (1) they are then concentrated on a smaller area, and (2) they have to pass through a shorter section of atmosphere, and therefore part with a smaller amount of heat. The more slanting the sun's rays, the less heating power do they have.



Division of the World into Zones.

2. Now the portion of the earth's surface where the sun's rays are vertical at some time during the year lies between the Tropic of Cancer (23½° N.) and the Tropic of Capricorn (23½° S.). Here the days and nights are of nearly equal length all the year round, the heating power of the sun is at its greatest, and the annual range of temperature is least. This portion of the earth's surface is accordingly known as the **Torrid Zone**, and places here, at or near sea-level, are said to have **a tropical climate.**

(1) The heat received from the sun throughout the whole year is greater near the equator than in any other region

because there the sun is always near the vertical position. The day is always of about the same length, namely, twelve hours. During mid-summer, near the tropics, however, the heat is greater than at the equator, because at this season the sun shines vertically, and it shines for a longer time each day than it does at the equator.

(2) In midsummer, at the tropics, the sun is above the horizon for about 13 hours, while at the equator it never shines for more than 12 hours continuously.*

3. North of the Tropic of Cancer, and south of the Tropic of Capricorn, the sun's rays are never vertical, but attain a more and more slanting direction as the Poles are approached. Between the tropics and the polar circles (66½° N. and 66½° S.) the days and nights are usually very unequal in length; but the sun is never above or below the horizon for 24 hours at a time. Here the heating power of the sun's rays, owing to their slanting direction, is less than it is in tropical regions, and the range of temperature is greater. In summer, however, owing to the greater length of the day, the full heating power of the sun may in some places approach that of portions of the tropics.

4. The portions of the earth's surface lying between these limits are known as the **Temperate Zones**; the North Temperate Zone lying between the Tropic of Cancer and the Arctic Circle, and the South Temperate Zone, between the Tropic of Capricorn and the Antarctic Circle.

The climates of any places near sea-level within the temperate zones are, on the average, neither very hot nor very cold, although the climate is warmer near the tropics than near the polar circles. Such places are therefore said to have a **temperate climate.**

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* See also page 63.

5. Within the polar circles are the **Frigid Zones**, where the days and nights (the periods of continuous sunlight or darkness) are more than 24 hours long. Here the direct heating power of the sun is small, because it never rises much above the horizon. As in summer the period of continuous sunlight, however, lasts from 24 hours at the polar circles to six months at the Poles themselves. the heat accumulates, as the loss by radiation is small. On the other hand, during the polar night, there is no heat derived directly from the sun, and the loss by radiation is large. The range of temperature, therefore, in the Frigid Zones is very great, and the Polar regions, on the average, have an exceedingly cold climate.

Influence on plant and animal life.—The influence of climate on plants and animals is particularly noticeable in the climatic zones as determined by latitude. Two places in the same latitude may have very different average temperatures, and therefore very dissimilar climates*; but, on the whole, distance from the equator determines the arrangement of climates at sea-level and has great influence on vegetable growth and animal life. Widely distributed plants, for instance, flower earlier in warm climates than they do in temperate or cold climates. This is noticeable even in New Zealand, where the common fruits and vegetables come to maturity in Auckland much earlier than they do in Dunedin or Invercargill.

When we pass from one climate or zone to another, too, we meet with different plants and animals. Such plants as palms and bananas, for instance, and such animals as lions, tigers, elephants, rhinoceroses, camels, giraffes and crocodiles, gorgeous plumed birds, and brilliant butterflies are native only to tropical or sub-tropical regions. In the temperate zones a different assemblage of plants and animals is met with; such as oaks, elms, poplars, birches, and pines; thrushes, larks, tuis, and other singing birds of a somewhat sombre plumage; mice, rats, weasels, badgers, otters, foxes, wolves and bears. In the polar regions the vegetation becomes more stunted and scanty, or almost entirely disappears; while the only animals there are those that have become acclimatised to the severe cold, such as polar bears, white foxes, reindeer, musk oxen, sea-birds, ptarmigan, owls, and other birds, mostly white-feathered.

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*Edinburgh and Moscow are in the same latitude, but the difference between the winter and summer temperatures of the former is 19° F. and of the latter is 49° F.

(2) *Influence of Elevation on Climate.*

1. As explained in a former lesson, the air is not warmed to any great extent by the sun's rays passing through it; but it is heated chiefly by contact with the warm surface of the land, and by the radiation of heat from it. A person walking across a glacier, for instance, may have his face scorched by the sun, although the air he breathes is icy cold. The occupant of a rising balloon feels the air getting colder as he ascends; partly for the reason that he is moving further away from the warmed surface of the earth, and partly because the air is getting rarer, and is, therefore, less capable of absorbing and retaining the heat radiated from the earth's surface. In fact for every 300 feet ascended the thermometer falls about 1° Fahrenheit.

2. For similar reasons plateaus and mountain tops are much colder than the valleys and low-lying plains near them, or in corresponding latitudes; and the snow-line in various latitudes indicates the different heights to which we must climb in order to reach a temperature at or near freezing point (32° F.) throughout the year.

3. Accordingly, the higher a place is above sea-level, the colder it is. Mountains and highlands, too, act as condensers to moisture-laden winds by forcing them up to where the rarity of the air causes expansion and a consequent drop in temperature. Hence more rain and snow fall there, as a rule, than on the lowlands. The land at sea-level in the Torrid Zone becomes very warm in the sunshine, and yet

adjacent highlands may at the same time be very cold. Even at the equator the tops of lofty mountains are covered with perpetual snow.

Influence on plant and animal life.—Even in tropical countries, all kinds of climate, from the burning heat of the Torrid Zone to the icy cold of the polar regions, may be met with by anyone ascending the lofty mountain ranges. Similarly, all the different forms of vegetation and many of the animals usually found only in the temperate or frigid zones may be found at different elevations in tropical regions.

"We can readily perceive that the times of flowering and ripening of the same plants must become later, in proportion to the height of their place of growth, until at last the ground is too high and bleak to let them ripen at all before the winter sets in. They have thus an upper limit beyond which they cannot extend. But while they disappear, other plants, better able to withstand the rigorous climate of the uplands, take their place. As we climb to higher elevations the familiar vegetation of the plains is gradually succeeded by a vegetation peculiar to the mountains, until at last we reach the edge of the snow-line."

This is known as the *vertical* distribution of vegetation.

(3) *Influence of Large Land or Water Areas on Climate.*

1. As land heats quickly and cools rapidly, a place that is surrounded by a large tract of land will usually become very hot in summer and very cold in winter. For a similar reason its nights will be very much colder than its days. The climate of such a place, as already noted, will be a **continental** one. A continental climate is also on the whole a dry climate, as the moisture-laden winds from the sea shed their moisture over the land, particularly on the highlands and mountains, before they get far inland.

2. As water heats more slowly and also cools more slowly than land does, there will not be so much difference between its daily and nightly, or its

summer and winter temperatures, as those of the land. Winds that for any reason may happen to be blowing from the sea towards the land in summer, or during the day, will be comparatively cool winds, and will therefore help to lower the temperature of the air over the land. On the other hand off-sea winds, in winter, will be comparatively warm, and will therefore tend to warm the air over the land.

3. The climates of moderate-sized islands, and of places on or near the coasts of continents, as they are tempered by the sea, will as a rule be not so warm in summer, nor so cold in winter, as those of places in the interior of continents. Also, as winds blowing from the sea towards the land are usually heavily charged with moisture, such places will generally have a moister climate than will those situated at a low level far inland. In other words, places situated in islands of moderate size, or near the coasts of continents, will have an insular climate, where the yearly range of temperature is not very great, and where the rainfall is either moderate or considerable, according to whether the elevation is low or high.

4. Again, as we have seen, the climate of small islands of moderate elevation in the open ocean will be **oceanic.** The difference between the summer and winter temperatures will be small, often as low as 5° or 6°; and the rainfall of such islands will also, to a great extent, depend on their elevation.

The influence of the sea on insular climates may be noted in the cases of Sydney and Auckland. These places are in about the same latitude (34° and 36° S.); but Sydney on the east coast of Australia, with a large continental area to the west of it, and an ocean on the east, has a mean summer temperature of 80° F., and a mean winter temperature of 50°—a range of 26°, while Auckland, occupying the narrow neck of a peninsula between the Tasman Sea and the Pacific, has a mean summer temperature of 73° and a mean winter temperature of 56°—a range of only 17°. It is noteworthy that, owing to the influence of the sea on both sides of it, the summer temperature of Auckland is lower than that of Sydney, while the winter temperature is higher, although both places are in the same latitude, and are situated on the shores of a great ocean.

5. The presence of lakes in a country helps to modify the climates of places near them. Their surface water is chilled by the cold of winter and so sinks to the bottom, forcing a warmer layer to the top, which in its turn becomes chilled and sinks, forcing another warmer portion to the surface. Accordingly, the temperature of the air overlying the water is kept higher than that of the air over the adjacent land, while the colder air from all sides flows down to the lake, and is there warmed.

"Many deep lakes do not freeze in winter, and so serve as reservoirs of warmth to keep the temperature of the surrounding ground higher than that of places only a short distance away. On the other hand, during summer the water cools the air lying upon it, and thereby lessens the heat of the surrounding country."

(4) *Influence of Prevailing Winds and Ocean Currents on Climate.* 28th-10

1. **Prevailing Winds.**—The surface waters of the ocean evaporate more readily in warm than in cold regions. Consequently, winds blowing from tropical seas are more heavily charged with moisture than those blowing from colder seas. The former, therefore, bring both warmth and moisture to the countries across which they blow, while the latter tend to lower the temperature of a coast, and affect its rainfall to a lesser degree.

(1) The prevailing westerly winds blowing from Australia across the Tasman Sea bring both warmth and moisture to the western shores of New Zealand. In the

South Island, particularly, much of this moisture is condensed into rain and snow on the western slopes of the Southern Alps, thus making the climate of Westland very moist. During the process of condensation a large amount of latent heat is set free. This raises the temperature of the air, and the familiar "nor-wester" then blows down the eastern slopes of the Alps, and across the Canterbury Plains, as a warm, dry, wind.

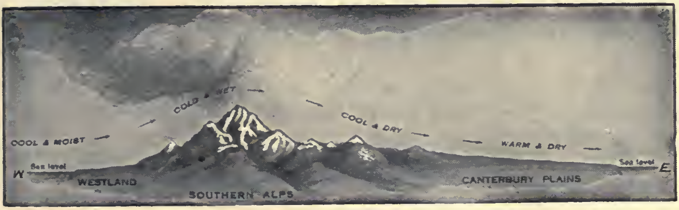

Diagram showing wetter and drier sides of a range of mountains.

(2) Similarly, the southerly winds from the Antarctic are cold winds, and although for that reason they are not so highly charged with moisture as the westerlies, they lower the temperature of the southerly shores of New Zealand, and also bring to them an abundance of moisture.

2. Winds that blow from the interior of continents are, as we have seen, dry winds, generally hot in summer and cold in winter.

3. **Ocean Currents**, by affecting the temperature of the air blowing across them, influence the climates of places past or near which they flow. If the current is flowing from tropical regions to colder latitudes, it raises the temperature of the breezes blowing in the same direction, thus heightening the temperature of the neighbouring shores. On the other hand, if the current flows from polar regions towards the equator, all the coasts it reaches will be made much colder by its approach.

(1) The New South Wales Current, a branch of the South Equatorial Current, carries its heated waters past eastern

Australia and western New Zealand, and thus helps to warm the westerly winds that bring warmth and moisture to the western shores of New Zealand; while the cold Antarctic Current flowing along the southern and eastern coasts helps to lower the temperature of the southerly winds that bring moisture to those shores.

(2) The Gulf Stream, from the heated waters of the Caribbean Sea and the Gulf of Mexico, flows across the Atlantic and washes the western shores of Europe, thus helping to raise the temperature of the westerly winds that bring warmth and moisture to the British Isles and Norway. The west coast of the latter, although it projects into the far north, is free from ice all the year round, while the coast waters of the Black Sea, very much farther south, are icebound in winter.

(3) A cold polar current washes the shores of Labrador, thus helping to cool the air around, and contributing to the result that Labrador is a region of almost perpetual ice and snow, although it is in the same latitude as the British Isles, which enjoy a perennially mild climate partly owing to the Gulf Stream and the westerly winds it has warmed.

4. **Influence on Vegetation.**—As prevailing winds and ocean currents affect the climate of a country, they also affect the nature and growth of its plant and animal life. Vegetation grows most plentifully in those districts which receive a plentiful supply of heat and moisture, and the character of the vegetation is also much affected by the same causes. For instance, Westland, which receives a larger precipitation of moisture from the Tasman Sea than Canterbury does from the Pacific, is naturally much greener and more luxuriantly clothed with vegetation than the latter. The westerly winds, too, bring an abundance of rain to Taranaki, causing the grass to grow green and luscious, thus helping to make this province the chief dairying district of New Zealand.*

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*Mean annual rainfall of New Plymouth for 36 years is 60 inches.

(5) *Influence of Directions of the Mountain Chains, and the aspect or General Slope of the Land, on a Country's Climate.*

1. From what has been already said it is evident that the position and direction of a country's mountain ranges will greatly affect its climate. For mountains often shut out polar winds from part of a country, or intercept moisture-laden or warm winds, and thus affect both their temperature and moisture.

(1) The Southern Alps of New Zealand, running in a northerly and southerly direction through the South Island, intercept the moist westerly winds from the Tasman Sea, making the west coast moister, and the east coast drier, than would otherwise be the case.

(2) In Australia, the Australian Alps, and the ranges of the Great Divide, which run along the east coast from Bass Strait nearly to Cape York, intercept the moisture of the rain-bearing winds from the Pacific, and thus cause plenty of rain to fall on the eastern coast lands while leaving much of the interior almost rainless.

(3) Northern Europe is warmer than the corresponding latitudes of Asia and North America; mainly for the reason that its elevated lands, being further north than those of Siberia or Canada, shut out the cold Arctic winds and thus shelter the greater part of the country to the south. The Himalayas, again, prevent the cold Arctic winds from blowing over Southern Asia, and their Southern slopes intercept the moisture brought by the south-west monsoons from the Indian Ocean, thus helping to cause the fertility of India and China.

2. In Asia and North America, too, owing to the position and direction of most of the principal mountain chains, more of the land slopes towards the cold regions of the Arctic (that is, away from the sun) than is the case in Europe, where most of the land slopes towards the equator, that is, in the direction of the sun.

When the land slopes towards the sun it receives more of the sun's rays than when it slopes away from the sun. Consequently, in the northern hemisphere, land that has a southerly aspect, and in the southern hemisphere, land that has a northerly aspect, will be warmer than land sloping in the opposite direction. The climate of Northern Europe is on the whole warmer than that of similar latitudes in Asia and North America, because more of the land there slopes towards the equator, that is, in the direction of the sun, than is the case in either of the other two continents.

(6) *Influence of Soil, Cultivation, and Forests on Climate.*

1. The nature of its **soil** has some effect on the climate of a place. A dry, sandy desert readily absorbs the sun's heat during the day, but it cools very rapidly by radiation in the night, often to such an extent that on a clear night it may become icy cold. Wet, marshy land, on the other hand, lowers the temperature, for the reason that the water in it absorbs and conveys away the heat that would otherwise warm the soil. When swamps are drained, therefore, the temperature of the air above the drained area becomes higher than before.

2. Another effect of **cultivation** is to clothe the surface of the tilled land with a thicker covering of vegetation than formerly. This prevents the soil from being either warmed or chilled to the same degree as when it was bare of verdure. The vegetation screens the soil from both heat and cold, helps to retard radiation, and, as the leaves of the plants never become so hot as the soil itself, they help to make the temperature more equable.

3. It is evident, also, that for the reasons stated **forests** will have some influence on the climates of the places near which they are situated. They lower the summer temperature by increasing the radiating and evaporating surfaces, and by increasing the cloudiness of the districts in which they occur. They

therefore help to increase the moisture of the air, and probably cause it to be more readily precipitated.*

4. After a heavy rainfall, too, by acting as a screen from the sun, they help to retard direct evaporation, while their roots prevent the water from flowing away as quickly and freely as if it had fallen on the bare ground. This accounts for the fact that the rivers of forest country are rarely subject to floods.

"N.Z. Graphic" photo

Floods at Foxton near the mouth of the Manawatu River, attributed to the deforestation of the upper part of the river basin.

PART II.

MATHEMATICAL GEOGRAPHY.

1. THE EARTH'S DAILY ROTATION.

1. That the earth turns round on its axis daily, taking about 24 hours to make a complete rotation, may be inferred from observing the apparent daily movements of the sun, moon, and stars.

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*N.Z. scientists assert that the destruction of our forests does not diminish the rainfall of the country. Why?

1. Apparent Daily Motion of the Sun from East to West.

(1) The North and South Line in the playground (described in Standard 3 Geography) is called the **meridian** of the school (L. **meridies** = midday) because it serves to indicate the position of the sun at midday—that is, due north.

With the help of the upright post, formerly described, observe the directions of the sun's shadow at 9, 10, and 11 a.m., at noon, and at 2, 3, and 4 p.m. respectively, local time. On a sheet of paper placed horizontally, mark the directions of these shadows in reference to the meridian, or north and south line, also shown on the paper.

(2) The shadows will be seen to move gradually from west to east, or in the opposite direction to the hands of a clock; while the sun seems to move across the sky from east to west.

(3) By experimenting with a lighted candle and an upright needle in a semi-darkened room, children may be led to see how the circle of light on a slowly rotating globe, passes round the globe as it is turned on its axis.

(4) Again, place the candle towards the east of the globe, and slowly rotate the globe towards the stationary candle—that is, from west to east,—and note that the different places (marked with chalk) on the shaded side are first turned into the circle of light, and then into the circle of darkness.

(5) Similarly, carry the lighted candle round a stationary globe, so that the circle of light passes round the globe as before, and the chalk-marked places will appear alternately in light and in shadow as previously happened.

(6) In the last two experiments, if an upright needle be placed between the globe and the lighted candle, the directions of its changing shadows as the light from the candle moves round it are similar to those of the post shadows cast by the sun.

(7) We may thus infer that the regular change of direction from west to east in the shadows of the playground post, as the sun appears to cross the sky, are caused either by the sun's moving round the stationary earth, or by the earth turning round on its own axis, the sun being stationary.

Which of these explanations is the correct one? Before we can answer this question we must enquire a little further.

2. Apparent Daily Motion of the Moon from East to West.

(1) In a somewhat similar manner the apparent motion of the moon can be observed, say, when that body is 8, 9, or 10 days old, as it is called. If this be done, it will be found that the moon, like the sun, appears to rise in the east and set in the west; and that the shadows cast by the playground post when the moon is shining move in a direction similar to that in the case of the sun.

(2) We have therefore to suppose as before that the only two explanations which seem to fit the facts are, either that the moon revolves round the earth in 24 hours, or, that the earth rotates on its axis in the same time.

Again we may ask, which of these two explanations is the correct one? The answer will be indicated directly.

3. Apparent Daily Motion of the Stars from East to West.

(1) The changing positions of some of the brighter stars of the northern heavens may be observed at different times on two or three evenings.[*] If another upright post be placed in the playground at the southern end of the north and south line (the meridian line), an observer stationed there and looking along the meridian line to the northern post will readily see when any given star crosses the line of the meridian.

(2) A bright star should be chosen that is a little to the east of the meridian, say towards 8 p.m.,[†] when its position may be roughly marked on a sheet of paper on which the north and south line is drawn. The star will be first observed to approach the meridian line, then to cross it, and then to move away from it towards the west. These different positions may be marked on the paper, as in the diagram on page 82.

(3) If similar observations be made of the same star on two or three suitable nights in the same week or month, the same change of position will be seen to occur; that is, the star will appear to approach the meridian from the east, cross it about 8 p.m., and then to move away from it towards

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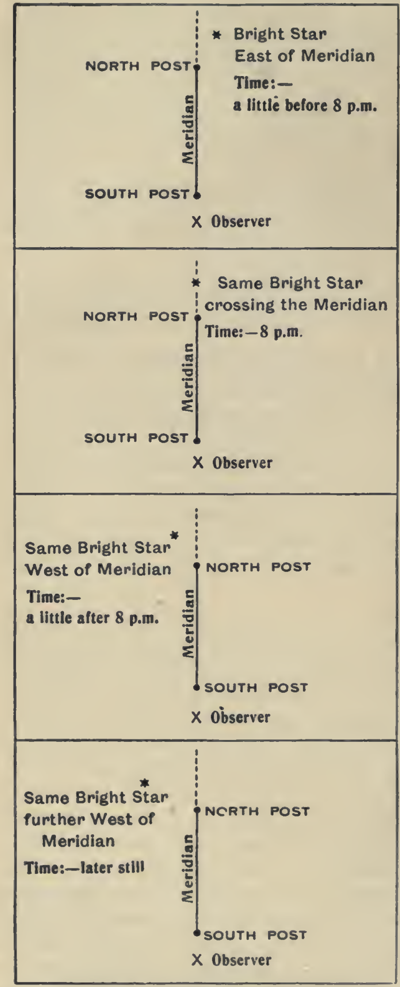
[*] A few of the children living near the School might attend in the playground on a suitable night or two to make the observations.

[†] The names, altitudes and times of some of the brighter stars of the northern and southern heavens are given on pp. 30 to 33 of Hogben's suggestive little book previously referred to—"*Rough Notes on the Teaching of Mathematical Geography.*"

the west. If other stars be observed, a similar apparent change in their positions will be seen to occur.



The position of the same bright star recorded at four short intervals of time.

(4) If the stars in the southern sky (say those forming the Southern Cross) be similarly observed, by looking along the north and south line, from the northern towards the southern post, the stars will apparently cross the meridian in a similar manner—that is from east to west—the east being then on the observer's left hand, and the west on his right hand.

(5) These observations concerning the apparent changing positions of the stars in relation to the meridian, like those already noted concerning the sun and moon, can be accounted for only on the supposition that the earth is rotating on its axis, or that the stars are revolving round it.

4. The Correct Inference.

(1) Owing to the great, and different distances from the earth of the heavenly bodies under observation, and the fact that their apparent rate of progress from east to west is the same, we must assume it to be

impossible that the neighbouring moon, the distant sun, and the still further away stars, could all be travelling round the earth, covering vastly different and incredible distances in 24 hours.

(2) Hence we are compelled to conclude, in the absence of any explanation which more thoroughly accounts for the observed facts, that the apparent procession of the sun, moon, and stars from east to west every day or night, is due to the rotation of the earth on its axis—an explanation which entirely fits in with our observations, as well as with the experiments of the lighted candle and the globe.

SUMMARY.

That the earth rotates on its axis once in every 24 hours may be inferred from observing, with the help of the north and south line, (1) the apparent daily motion of the sun from east to west; (2) the similar motion of the moon; (3) the apparent regular motion of the stars from east to west.

2. THE EARTH'S AXIS.

1. The **axis** of the earth is an imaginary straight line passing through its centre from pole to pole, upon which the earth may be supposed to turn. This line is at right angles to the plane of the equator.

(1) In the school globe this line may be represented by a very fine, straight inflexible wire passing through both poles.

(2) The axis of a peg-top is the line joining the point of the steel peg with the centre of the wooden peg at the opposite end.

(3) The axis of a garden roller is the iron bar through its centre.

2. If a boy's peg-top be spun on a level floor so as to describe a circular path round a large marble as centre, three important facts may be noticed.

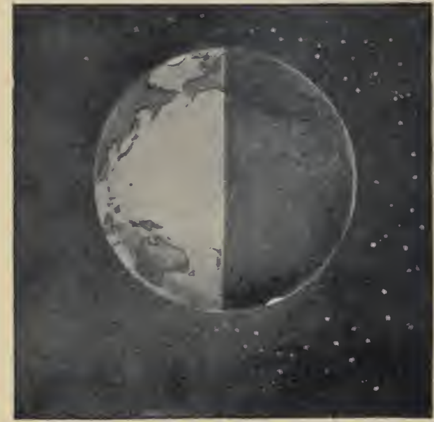
(1) The top is spinning round rapidly on its own axis.

(2) While it is thus rotating, it is also revolving round the marble as a centre.

(3) All the time it is continuing to move round the marble it is not quite upright, but is leaning inwards; or, in other words, its axis is inclined at an angle to the floor on which its circular path is described.

3. If the marble be taken to represent the sun, the top may be taken to represent the earth (1) rotating on its axis (its daily motion); (2) revolving at the same time round the sun (its yearly motion); while (3) the slant of the top's axis towards the floor will roughly illustrate the inclination of the earth's axis to the plane of its orbit, or path round the sun.

Later on we shall learn that the direction of the earth's axis never varies; its constant inclination being 66½° to the plane of the orbit. In other words, the opposite ends of the straight line joining the north and south poles always appear to point towards the same two opposite spots in the heavens, which are known as the North Pole of the sky (the Celestial North Pole), and the South Pole of the sky (the Celestial South Pole), respectively.


Appearance of the Earth if it did not rotate. Note the position of the north and south poles, owing to the slope or inclination of the earth's axis to the plane of its orbit.

SUMMARY.

The earth's axis is an imaginary straight line, running through the centre of the sphere from pole to pole, round which the earth turns. It is always directed towards the same point in the heavens. Earth's daily rotation, and annual revolution round the sun, may be illustrated by a top spinning in a circle round a marble on the floor.

3. DAY AND NIGHT.

1. The sun is always shining on a portion of the earth's surface. If the earth did not turn round on its axis, one-half of its surface would always be

brightened by the sun, while the other half would remain in darkness. That is to say, one-half of the earth's surface would enjoy perpetual day, while the other half would experience everlasting night.

2. As the earth does rotate on its axis, however, all places on its surface are being constantly turned, first towards the sun, and then away from it. Light and darkness, **day** and **night**, thus follow each other in regular succession. During a portion of every twenty-four hours most places on the earth's surface experience day, and during the remaining portion, night.

3. Day and night are therefore caused by the daily rotation of the earth. The slope of the earth's axis causes the variations in the lengths of day and night respectively—a matter that will be explained later on.*

SUMMARY.

The alternation of day and night is caused by the earth's rotation on its axis; it being day when a place is in the presence of the sun, and night when the place is in shadow.

4. MERIDIANS.

1. If the North and South line of any place be produced far enough both ways it will touch the North and the South Poles. The earth being a spherical body, as already shown, this line forms a semicircle, called a **meridian**, extending from pole to pole. If this line be further continued it will form another semicircle or meridian on the opposite side of the globe, marking the north and south line of all places through which it passes.

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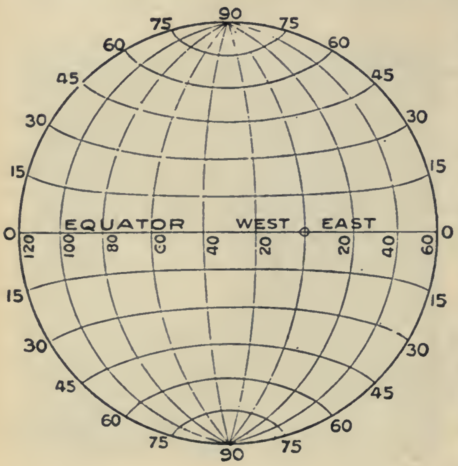
*See page 108.

2. All places through which the same meridian runs must have **noon** at exactly the same moment of time; because at that time exactly the sun is either due north or due south of each one of them.*

3. For the sake of convenience and uniformity the north and south line which passes through the Observatory of Greenwich, near London, is called the **First Meridian.** It is marked on the globe, or on the map of the world, in most countries, as 0°. Other meridians are numbered east and west from this line along the equator to correspond with the 360 degrees into which a circle is usually divided. There are consequently 180 meridians east of Greenwich, and the same number west of it; the 180th meridian in either case being the same line, as it is the opposite half of the continuous circle of which the First Meridian is one half.



Parallels and Meridians. Note the First or Greenwich Meridian. The diagram also shows the unvarying length of a degree of latitude, and the decreasing length of a degree of longitude as the Poles are approached.

4. The distance between any two consecutive meridians at the equator is the length of the arc of that circle (the equator) lying between them.

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*Within the tropics the sun may be exactly overhead at 12 o'clock noon.

As there are altogether 360 meridians (180 on either side of the globe) stretching across the equator from pole to pole, they will divide the equator and all circles parallel to it into 360 equal arcs, each measuring 1° in length. The length of the equator, as we shall see later on, is about 25,000 miles. Therefore, the length in miles of the arc between any two meridians at the equator is roughly $\frac{25,000}{360}$ miles; that is, the length of a degree of longitude at the equator is roughly about 70 miles. Nearer either of the poles, the value of a degree of longitude at any point is less than 70 miles, owing to the convergence of the meridians, as will be presently shown.

5. Similarly, as all the meridians meet at the poles, the angle between any pair of them is $\frac{1}{360}$ of a circle, or 1°. In other words, in angular measurement the distance between any pair of meridians is one degree (1°).

SUMMARY.

The meridian of a place is its north and south line. On a globe, or model of the earth, it is represented by a semi-circle extending from pole to pole at right angles to the equator. Places on the same meridian are therefore either due north or due south of one another and have noon at exactly the same moment of time. The 1st meridian is the semi-circle passing through Greenwich and is numbered 0 degrees; the opposite semi-circle passes through the Fiji Islands and is numbered 180°. Other meridians are numbered in degrees east or west from 1st meridian, there being 180 of them on either side. The distance between any consecutive pair of meridians = 1°, which, at the equator, measures about 70 miles. All meridians meet at the Poles.

5. LONGITUDE.

By the **longitude** of a place we mean its distance east or west from the First Meridian, measured in degrees, minutes and seconds along the equator, or along a circle passing through the place, and round the earth, parallel to the equator.

(1) The town of Cupar in Scotland, is on the 3rd meridian west of Greenwich. That is, it is 3° west of Greenwich, or is situated in longitude 3° W.

(2) The town of Bourke in New South Wales, Australia, is on the 146th meridian east of Greenwich; that is, it is 146° east of Greenwich, or its longitude is 146° E.

(3) Similarly the longitude of Gisborne in New Zealand is 178° 07′ E.; that is, it is 178 degrees and 7 minutes east of the first meridian; while Timaru is situated in East longitude 171° 15′ 19″; that is, it is 171 degrees 15 minutes and 19 seconds east of the First Meridian.

(4) As there are 180 meridians east, and the same number west of the First Meridian, which is marked 0°, the most easterly or westerly longitude a place can have is 180°, while the longitude of any place through which the First Meridian passes is 0°. If, therefore, we wish to know the difference in longitude between two places we shall have to know whether they are both east or west of the First Meridian, or whether one is east and the other is west of it.

1. Varying Lengths of Degrees of Longitude.

1. As any pair of meridians are widest apart at the equator and meet at the poles, it is plain that, though the angle between them is always the same, a degree of longitude when measured along the equator is greater in length than one measured along a parallel but necessarily smaller circle nearer the poles. A glance at the school globe will readily show this.

2. The distance between any adjoining pair of meridians at the equator, as has just been shown, is, roughly 70 miles, but as all meridians gradually approach one another until they actually meet at the poles, the lengths of the parallel arcs between them are always becoming shorter, until at the poles the distance between the meridians is zero.

3. We shall presently see how to find the actual distance in miles between any consecutive pair of meridians at any spot between the equator and the poles: that is, we shall find what the length in miles of a degree of longitude at any place is.

(1) If two places are both either east or west of Greenwich the difference of longitude between them is found by subtraction. Thus, Petrograd (Russia) is 30° east of Greenwich. while Calcutta (India) is 91° east of Greenwich. Therefore the difference of longitude between the two places is 91° – 30° = 61 degrees.

(2) But if one place is east of the First Meridian, and the other is west of it we must add their longitudes to find the difference. Thus, Calcutta is 91° east of Greenwich, and Philadelphia (America) is 75° west of it. Therefore their difference of longitude is 91 ° + 75° = 166 degrees.

(3) If, however, the sum of the longitudes of two places exceeds 180°, we know that they are separated by more than half the circumference of the earth in one direction, and consequently, by less than half the earth's circumference in the opposite direction. Therefore, to find their distance apart by the shorter measurement we must subtract the sum of their longitudes from 360°.

Thus the longitude of Yokohama (Japan) is 139½° East, while that of New York (America) is 76° West. They are therefore 215½° apart by the longer measurement round, or 360° – 215½° = 44½° by the shorter measurement. The actual difference between their longitudes is therefore 44½°.

(4) **To find the longitude of any point on the earth's surface,** turn the globe until the place is under the edge of the metal meridian circle, and notice what degree on the equator is under the same edge. If the place is east of Greenwich, it is east longitude; if west of Greenwich, it is west longitude.

(5) **To find all places having the same longitude,** find on the equator the required degrees east or west of the First Meridian, and rotate the globe till this number comes under the edge of the metal meridian. All places under this edge and on the same side of the poles will have the required longitude.

SUMMARY.

The longitude of a place is its distance (measured in degrees, etc.) east or west from the 1st meridian. As any consecutive pair of meridians are widest apart at equator and meet at poles, the value of any degree of longitude varies from 70 miles at equator to 0 at poles.

2. Local Time and Longitude.

1. When the sun is exactly north or south of any place, that is, when it is apparently in the act of crossing the meridian, or north and south line, of that place (therefore of all places on this same meridian), it is exactly 12 o'clock noon (local time).

Similarly, as the opposite face of the earth is then turned away from the sun, at all places through which the opposite meridian (the other half of the continuous circle) passes it will be exactly 12 o'clock midnight.

2. As the earth takes 24 hours to turn completely round on its axis, it follows that every point on its surface is turned through a circle, or 360 degrees, every 24 hours, that is, through an arc or angle of 15 degrees every hour, or through one degree in 4 minutes.

As the earth is revolving from west to east, every point on its surface (and therefore every meridian) is being turned alternately towards the sun (before noon) and then away from the sun (after noon) at the rate of 1° in every 4 minutes.

3. Places east of any given meridian, say the First Meridian, will accordingly have sunrise, or noon, before places west of the meridian. To be more exact, they will have noon 4 minutes earlier for every degree they are east of the First Meridian, or of any other place. Similarly, their noon will be 4 minutes later for every degree they are west of the first meridian, or of any other place.*

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*The inconvenience of *local* time, and the wide adoption of *standard* time may here be explained by the teacher. See "Junior Geography of New Zealand and Australia." or "Standard Time" in "The New Zealand Diary.'

EXAMPLES.

(1) The longitude of Rome (Italy) is 13° East, that is, Rome is 13° east of Greenwich, or of the First Meridian (0°). The difference of time between the two places is therefore 13 × 4 = 52 minutes. The local time of Rome will therefore be 52 minutes in advance of the Greenwich clocks. In other words when it is noon, say, at Greenwich it will be 52 minutes later on in the day at Rome, or the time at Rome will be 8 minutes to 1 o'clock in the afternoon (12.52 p.m.).

Conversely, if the difference in time between Greenwich and Rome is 52 minutes, and we learn from the map of the world (or from the later time at Rome) that Rome is east of Greenwich, we know that the longitude of Rome must be 52 ÷ 4 = 13° East Longitude.

(2) The longitude of San Francisco (America) is 122° W., and that of Petrograd (Russia) is 30° E. If it is 5 a.m. at San Francisco on any day, what will be the (local) time at Petrograd?

Here the difference in longitude between the two places is 122 + 30 = 152 degrees. The difference in their local times will therefore be 10 hours 8 minutes—one place being east and the other west of the First Meridian. If, therefore, it is 5 a.m. at San Francisco, the time at Petrograd will be 3.8 p.m.

Conversely, if it is 3.8 p.m. at Petrograd when it is 5 a.m. at San Francisco, this shows that the former place is east of the latter, and shows that the difference in longitude is 608 ÷ 4 = 152 degrees. If, therefore, the longitude of either place is known that of the other may be easily ascertained by subtraction.

SUMMARY.

As the earth makes a complete rotation (360°) from west to east in 24 hours, every place on its surface moves in a circle at rate of 1° in 4 minutes. Places on same meridian have noon at same moment of time. Places east of 1st or other meridian have noon 4 minutes earlier, and those west of it 4 minutes later, for every degree these are east or west of it. Illustrate by examples.

3. Longitude at Sea.

1. The captain of every ocean-going vessel carries with him on his ship one or more **chronometers**, or

watches specially constructed to keep correct time. The chronometer is set to Greenwich time, so that, if it is kept in good going order, the officers can always tell from it what the time at Greenwich is wherever the ship may happen to be. By observation with a sextant they can also tell when the sun is in the meridian; that is, they can tell when it is 12 o'clock noon where the ship is.

A marine (or ship's) chronometer, used to show accurate Greenwich time. The clock is balanced in its frame so as to be always horizontal. Every chronometer is carefully tested at the Greenwich Observatory. No chronometer may be used if its time varies at the rate of more than 13 seconds in a year.

2. Knowing, therefore, the local time and Greenwich time at the same moment, the captain can tell in what longitude the ship is, as shown above.

EXAMPLE.

The captain of a ship finds from observation that the sun is in the meridian (that is, that it is exactly 12 o'clock noon) where his ship then is, while his chronometer shows that the time at Greenwich at that moment is 3 p.m. What is the longitude of the ship?

Here it is plain that as Greenwich time is later than (that is, is ahead of) the local time of the ship, the vessel must be **west** of the First Meridian. As the difference of time is 3 hours the longitude of the ship must therefore be **45° West**.

Had the time by the ship's chronometer been 9 a.m.; or 3 hours earlier than the local time of the ship, this fact would have shown that the ship was 45° east of the First Meridian, or, in other words, that the ship was in 45° east longitude.

SUMMARY.

At sea, the captain of a ship may tell from observation of the sun when it is 12 o'clock noon where he then is. From his chronometer he can learn what o'clock it is at Greenwich at that time. From the difference in time between the two places he may readily find his longitude; for, every 4 minutes difference in time means 1° east or west of Greenwich.

6. LATITUDE.

1. The distance of a place north or south from the equator is called its **latitude.**

The **equator** is the largest circle that can be drawn round the surface of the earth with either pole as centre. If we look at the school globe we shall see that this great circle (which is marked 0°) is drawn round the globe at equal distances from the poles, and that other smaller circles, **parallel** to the equator, are also shown on the globe between it and the poles. These smaller circles, as well as any other similar parallel circles that may be drawn, are known as **parallels of latitude,** or, shortly, as parallels.

2. As the distance from pole to pole when measured along a meridian is 180°, or one-half the circumference of the earth, so the distance from the equator to either pole, measured along a meridian is 90°, or one quarter of the earth's circumference.

If, therefore, the equator is numbered as 0°, either pole will be marked 90°, as it is 90° degrees from it. No place can therefore have a latitude of more than 90°. Places north of the equator, accordingly, will be in north latitude, while those south of the equator will be in south latitude. The latitude of places on the equator is 0°, that of the North Pole is 90° north, while the South Pole is 90° south latitude. The latitude of other places may be anything between 0°

and 90° north or south. High latitudes are near the Poles, while low latitudes are near the Equator.

3. If two places are on the same side of the equator, the difference of their latitudes will be found by subtracting one from the other. If, however, they are on opposite sides of the equator the distance they are apart will be the sum of their latitudes.

EXAMPLES.

(1) Pekin (China) is about 40° north of the equator. The latitude of New Orleans (America) is about 30° north; while that of Mauritius, an island east of Africa, is about 20° south.

(2) Since Pekin and New Orleans are both north of the equator, their difference of latitude is $40° - 30° = 10$ degrees.

(3) New Orleans and Mauritius, however, are on opposite sides of the equator, so their difference of latitude is $30° + 20° = 50$ degrees.

(4) If a boy lived 20 miles due north of Christchurch, and a girl lived 30 miles due north of the same place, they would live at a distance of 10 miles from each other. If, however, the girl lived 30 miles south of Christchurch, while the boy's home was 20 miles north of it, the distance between their homes would be 50 miles.

SUMMARY.

The latitude of a place is its distance north or south of the equator (which is marked 0°) measured along a meridian of longitude, either Pole being marked 90°. The difference between the latitudes of the two places is the sum of their latitudes, if the places are on opposite sides of the equator; but their difference when they are on the same side of the equator.

Uniform Length of a Degree of Latitude.

1. As the circles of latitude are always parallel to the equator and to one another (for which reason they are called **parallels**),* the distance between any consecutive pair of them (measured on any meridian) is always exactly the same. This distance

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*Beware of using the meaningless expression " parallels of longitude.

is the length of the portion of any meridian between them. As the total length of a meridian is half the circumference of a circle (in this case half the circumference of the earth), or 180 degrees, therefore the distance between any two consecutive parallels of latitude is $\frac{1}{360}$ of the total circumference of the earth, or one degree.

2. Now the total circumference of the earth, as will be shown later on, is roughly 25,000 miles. Therefore the distance between any two consecutive parallels of latitude, when measured along a meridian, is $\frac{1}{360}$ of 25,000, or about 70 miles.*

3. The value of every degree of latitude, therefore, is (roughly) 70 miles. Accordingly, if we wish to find the distance in English miles between any two places on the same meridian, that is, having the same longitude, we must multiply the sum or difference (as the case may be) of their latitudes by 70.

EXAMPLES.

(1) The latitude of Rome (Italy) is 42° N. Rome is therefore 42 × 70 = 2940 miles north of the equator by the shortest distance.

(2) The latitude of Cape Horn (South America) is 56° S. Cape Horn is therefore 56 × 70 = 3920 miles south of the equator by the shortest distance.

(3) How far is Wellington (N.Z.) from the equator? Wellington is situated in 41° 16′ south latitude. Its distance due south of the equator is therefore $41\frac{16}{60} \times 70 = 2889$ miles (nearly).

(4) The latitude of Bordeaux (France) is 44° 50′ N.; that of London (England) is 51° 30′ N.; and their longitudes are almost the same. The difference of their latitudes is 6° 40″ (= $6\frac{2}{3}$ degrees). The shortest distance between their positions is therefore $6\frac{2}{3} \times 70 = 467$ miles (nearly).

(5) Danzig (Germany) and Cape Town (South Africa) are in nearly the same longitude. The latitude of the former is 54° 20′ N., and that of the latter is 33° 40′ S. How far are they apart as the crow flies?

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*More accurately 69½ miles.

Here Danzig is 54⅓ degrees north of the equator, while Cape Town is 33⅔ degrees south of the equator. The distance between them is therefore (54⅓° + 33⅔°) × 70 = 88 × 70 = 6160 miles.

(6) To find the difference between two parallels of latitude we must measure along a meridian of longitude.

SUMMARY.

As the circles of latitude are parallel to the equator and to one another, the distance between any consecutive pair of them, measured along a meridian of longitude, is always the same; and is equal to 1° or 70 miles nearly.

7. HOW TO FIND THE LENGTH OF A DEGREE OF LONGITUDE AT ANY LATITUDE.

1. As any two consecutive meridians are widest apart where they cross the equator, and converge towards the poles, where they meet, it is plain that a degree of longitude (which at the equator, as we have seen, is roughly 70 miles in length) gets gradually shorter as it appoaches the poles, where its length is zero.

2. If we wish, therefore, to ascertain the length in miles of a degree of longitude at any place between the equator and the poles—that is, at any given latitude—we must measure with a pair of dividers on the school globe the distance between any two adjoining meridians along the given parallel, and then see how many degrees it occupies on the equator. If we now multiply this number of equatorial degrees by 70, we shall have, roughly, the distance in miles between the two meridians at the given latitude. Say the two adjoining meridians are 15° apart, we must then divide the distance in miles already found by 15 in order to ascertain the length of one degree of longitude at the given latitude.

Examples and Questions.

1. What is the length of a degree of longitude in latitude 60°?

The distance between two meridians (15° apart) at the 60th parallel of latitude makes 7½ degrees when measured along the equator, and we know that one degree of longitude at the equator is (roughly) 70 miles in length. Therefore 7½° at the equator is 7½ × 70 = 525 miles. This distance is equal to the length of 15° at the 60th parallel. Therefore the length of one degree of longitude at the given parallel is 525 ÷ 15 = 35 miles (nearly). Similarly the length of a degree of longitude at latitude 40° is 53 miles.

2. What is the length of a degree of longitude at latitude 30°?

The distance between two meridians (15° apart) at the 30th parallel will measure 13° on the equator = 13 × 70 = 910 miles. The length of one degree of longitude at the 30th parallel will therefore be 910 ÷ 15 = 61 miles, nearly.

3. How far does the earth move from west to east at the equator in an hour?

Every spot on the equator moves through 360° in 24 hours, or 15° in one hour. Therefore the distance is (roughly) 15 × 70 = 1050 miles.

4. At what rate do places situated in different portions of the earth move from west to east at latitude (1) 30°? (2) at latitude 60°? (3) at latitude 80°?

(1) The earth rotates on its axis at the rate of 15° every hour (see above). Now the distance between the two meridians (15 degrees apart) at latitude 30°, when measured along the equator is 13°, that is 13 × 70 = 910 miles (roughly). That is, all places through which the 30th parallel of latitude passes move round in a circle at the rate of about 910 miles an hour.

(2) Similarly, at latitude 60° (see above) places move round at the rate of 525 miles an hour (roughly).

(3) Also, at latitude 80°, the distance of places 15° apart will be 2·6 degrees (nearly) when measured along the equator = 182 miles (roughly). They will therefore move at the rate of 182 miles an hour at the latitude mentioned.

SUMMARY.

Any two consecutive meridians are widest apart at the equator; the distance between them constantly diminishes as they approach the poles, where they meet. The value of a degree of longitude thus constantly diminishes. At the equator it is 70 miles nearly; at the poles it is nothing. To find its value at any place, measure its meridional, or longitudinal, distance there. This distance measured along the equator in degrees multiplied by 70 will give the required distance. Illustrate by examples.

8. SPHERICAL FORM OF THE EARTH.

Common Proofs.*

(1) As a ship goes away from the land, towards the horizon, its hull gradually disappears from the view of the people on shore. Then the lower sails, and finally the top-sails, are lost to view. Similarly, as a ship approaches the land, the sailors see the tops of the mountains before the lower lands and the towns by the shore come into sight. When a ship is lost to view beyond the horizon, it is hidden by the curvature of the earth.

(2) To anyone standing on the shore and gazing seaward, the horizon appears to be circular in form.

(3) On the journey from New Zealand to Britain and back again, travellers may go half round the world in one direction, and then reach home by continuing in the same direction and traversing the other half of the world; thus completing the circumnavigation of the globe.

(4) As we go north or south from the equator, some stars previously unseen come into view, while others previously seen disappear. People coming from England to New Zealand lose sight of the Pole Star shortly after crossing the equator, and gradually get sight of the Southern Cross; while people going northwards from New Zealand gradually lose sight of the Southern Cross, and the Pole Star comes into view. This would not happen if the earth were a flat surface.

(5) The shadow thrown by the earth on the surface of the moon during an eclipse of the latter is always of a circular

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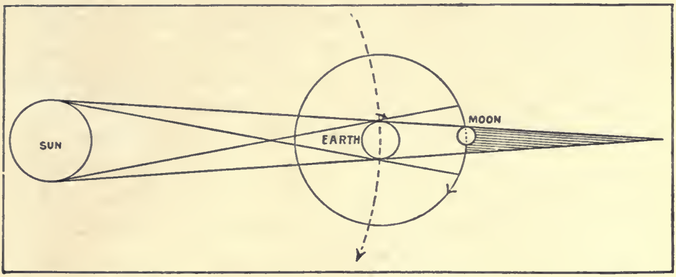
*See diagrams in Standard IV. book, pages 8 and 9.

shape. A sphere is the only body that always casts a truly circular shadow in whatever position it may be placed.

Common proofs such as these show that the earth is a spherical body.



Eclipse of the Moon. The Earth's circular shadow is thrown on the Moon

9. APPROXIMATELY STABLE POSITION OF THE EARTH'S AXIS.

1. The earth's axis is an imaginary straight line, passing through the centre of the earth from Pole to Pole, round which the Earth rotates. Its inclination is always the same; that is to say, its northern end (North Pole) always points to the same fixed point in the heavens, known as the North Pole of the sky*; while its southern end (South Pole) always points in exactly the opposite direction to another fixed point in the heavens, known as the South Pole of the sky.

2. The position of the Pole Star (invisible in New Zealand) may be taken to be approximately that of the Celestial North Pole. People in England, or in other parts of the Northern Hemisphere, may notice that the Pole Star is always over the same house, tree or other landmark, and that it is always at the same height above this object.

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*The Pole Star describes a very small circle, or apparent circular path, in the heavens. The centre of this circle is the Celestial North Pole.

3. To find the Celestial South Pole, children in New Zealand should be taught by their teacher to recognise the bright star Achernar in the southern heavens. The point about half-way between this star and the Southern Cross is right over the South Pole of the earth; that is, this point is the South Pole of the sky. If a person stands, say, at his garden gate and, looking southwards, notes what tree, house, or other landmark in the distance, is exactly underneath the point referred to, he will find from repeated observations during the year that the South Pole of the sky is always immediately above the tree, house, or other landmark previously noted.

4. Observations such as these, coupled with similar observations made in regard to the Pole Star by people in the Northern Hemisphere, show that the North and South Poles of the earth always point to the same two fixed points respectively in the heavens, and therefore that the imaginary line joining them (the axis of the earth) does not wobble, but is always in the same position, with one end pointing to the North Pole of the sky, and with the other directed towards the South Pole of the sky.

10. ANNUAL REVOLUTION OF THE EARTH AROUND THE SUN.

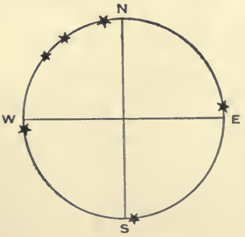
1. If a pupil, while facing the north, stands at the southern end of the North and South Line in the playground, he will be looking in the direction of the sun's position at noon. If he does this on a given evening in winter, say at 7 o'clock, he will be able to notice the position of any bright star, say, on his left hand. Let him roughly mark the position of this star on the page of an exercise book on which the North and South Line, forming the diameter of

a large circle, has been previously drawn. Another diameter, intersecting the former at right angles, and thus dividing the circle into quadrants, may also be drawn.

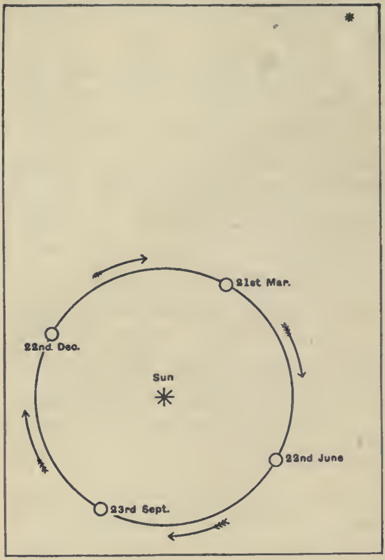
2. A fortnight later, at the same hour, let him similarly examine the star previously observed, and again mark its position on the diagram. On doing so he will find that the star appears to have moved westward, although the daily position of the sun at noon has of course remained unchanged. If a third observation be made in another fortnight at the same hour, and the result be duly noted, the star under observation will appear to have moved still further westward. In three months' time from the first observation the position of the star will be further westward still, and the total changes in position during that time will be denoted on the paper by about one-quarter of a circle.

3. If these observations were continued at intervals throughout the year, the star under observation would appear to have described a complete circle during that period, as shown in the diagram below, that is to say, if it were one of those, like the stars forming the Southern Cross, which can be seen on any clear night.

4. Now the star under observation, which has appeared to move westward in a circle, would have had the same apparent motion if it had been a stationary body, and the earth were revolving round a stationary sun. For this and other reasons astronomers are quite certain that the earth makes one complete revolution round the sun every year.



5. Other reasons for believing that the earth revolves round the sun are:—



After Hogben

Earth in four positions in relation to distant star.

(1) Certain stars, which may be seen at one period of the year, pass out of our sight, and reappear after a year's interval in the same place, while other stars come into view and then disappear again in their turn. These regularly recurring changes show that the earth is continually changing its position in the heavens.

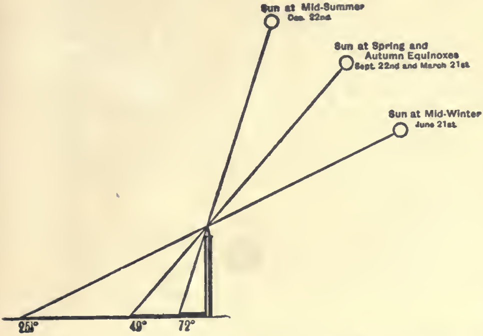
(2) On or about March 22nd the sun rises due east. From then until about June 22nd it rises farther and farther towards the north. From June 22nd to September 23rd it appears to return again towards the east, and then continues to rise farther and farther south until December 22nd; from then until March 22nd it is journeying back to due east. If the earth remained in the same position in the heavens the sun would seem to rise at the same points on the horizon every day.

11. HOW TO MEASURE THE MERIDIAN ALTITUDE OF THE SUN AT THE EQUINOXES AND THE SOLSTICES.

1. We can easily notice that the sun is higher up in the sky at noon in mid-summer than it is in mid-winter. From mid-winter to mid-spring, and on to mid-summer the noonday sun is daily getting higher in the sky; while from mid-summer to mid-

autumn, and on to the middle of winter its noonday position is getting steadily lower.

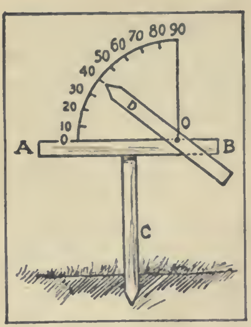
2. We may roughly measure the height of the noonday sun above the horizon in either of the following ways:—



Different lengths of shadows at different seasons. The angles mark the inclination of the sun's rays (that is, its meridian altitude) at Wellington.

(1) We may fix a post quite upright in the ground, and at noon on or about December 22 (mid-summer), March 22 (mid-autumn), June 22 (mid-winter), and September 22 (spring equinox), we may observe the lengths of the shadows cast by the post on these days respectively. If we also measure the height of the post above the ground, together with the shadow lengths mentioned, we can draw them to scale, as shown in the figure above. Now draw a line from the end of each shadow to the top of the post in the diagram, and measure with a protractor the angle it makes with the level ground. As this line if continued far enough would reach the sun, the angle it makes with the level ground will be the angular measurement of the sun's height above the horizon. In other words, we shall have found what is the meridian, or mid-day, altitude of the sun on the days mentioned.

(2) Another method of finding the sun's altitude would be by using an instrument (which can be easily made by anyone) like the one on page 104. This is a quadrant, roughly made out of a piece of board, the circular rim of which is divided into degrees, from 0° up to 90°, as shown. The quadrant is attached to a horizontal strip of wood *AB*, placed in the direction of the North and South Line, and fixed to a vertical post *C*. *D* is a pointer capable of moving stiffly in a vertical circle about *O*.



At noon move the pointer until it is in an exact line with the sun, which is then due north, and note the angle (as shown by the figure on the quadrant opposite the pointer) at which it stands. This will be the meridian (Latin *meridies* = midday) altitude of the sun. Near Wellington, on March 21st and 22nd (the autumn equinox) and September 22nd (the spring equinox), the noonday sun will be found to be roughly 49° above the horizon. On June 22nd (the winter solstice), its altitude will be about 25°; and on December 22nd (the summer solstice), about 72°.

For places north of Wellington the height of the noonday sun above the horizon will be a little more, and for places south of Wellington, a little less, than those given in the last paragraph.

3. These observations give us the meridian altitude of the sun. From them we recognise that the sun appears to climb higher in the sky, and therefore has a longer daily path across it, in summer than in winter. It rises earlier and sets later in summer than in winter; and we know (for the reasons given on page 64) that it has greater heating power when it rises high in the sky than when it apparently describes a smaller circle. At the equinoxes it rises at about 6 a.m. and sets about 6 p.m.

(1) The period about the 22nd December is called the **Summer Solstice** (Latin *sol*, the sun, and *sto*, I stand), because the sun having then reached its highest point in the sky does not get noticeably lower for a few days. After that its daily altitude decreases until about March 22nd, when the days and nights are of the same length. This period is called the **Autumn Equinox** (Latin *aequus*, equal, and *nox*, night), the period of equal day and night.

(2) The sun's altitude continues to decrease until about June 22nd, when it reaches its lowest point in the sky, and

is again apparently stationary for a day or two. This period is known as the Winter Solstice. From then onward until September 22nd (the Spring Equinox), and later still, until midsummer again, the sun's altitude increases.

4. At the Equinoxes the sun's noon rays are vertical at the equator; that is to say, its meridian altitude is 90°. It rises due east and sets due west; and the day and night are each twelve hours in length. In our summer solstice, the sun's noon rays are vertical at the Tropic of Capricorn. The sun then rises to the south of east, and the day is much longer than the night. In our winter solstice the noonday sun is vertical at the Tropic of Cancer. It rises to the north of east, and the night is much longer than the day.

The diagram on page 106 shows the sun's apparent path at different seasons.

12. HOW TO FIND THE LATITUDE OF THE SCHOOL.

1. At the equinoxes (March 22nd and September 22nd) the sun's noon rays are vertical at the equator. If a boy were at the equator on either of these dates, at noon the sun would be right over his head. That is to say, its altitude would be 90°. Suppose that the sun were to "stand still" while the boy travelled in a direct line to the South Pole. As he proceeded south, the sun would appear to sink lower and lower in the sky—1° lower for every degree of latitude he travelled south. When he reached the South Pole—latitude 90° south—the sun would be just on the horizon, and its noon altitude at the Pole would therefore be 0°. When he had gone (say) 30° from the equator, his latitude would be 30° S. and the sun would have sunk 30°. That is, its altitude would be 90° - 30° = 60°. The example therefore shows that if the sun's altitude be measured at noon

in any place, at the equinoxes, the latitude of the place will be the difference between 90° and the sun's altitude.

Thus, the sun's altitude at Wellington on March 22nd or September 22nd is roughly 49°. Therefore the latitude of Wellington is 90° – 49°, or 41° S. Conversely, if we know the latitude of a place, we may find the sun's noon altitude there, at either of the equinoxes, by subtracting the latitude from 90°.

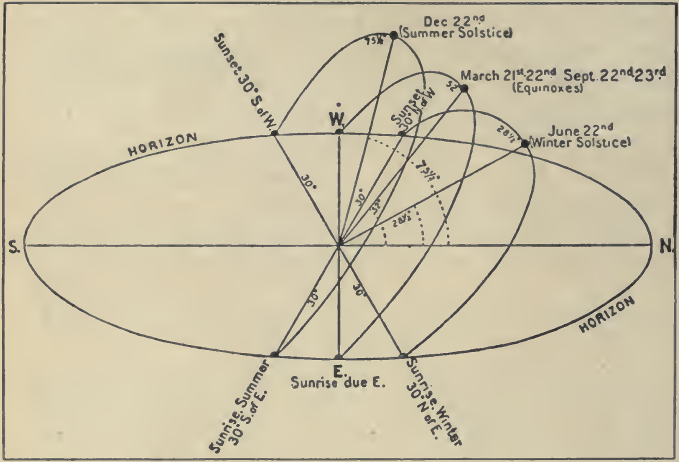

Dec 22nd (Summer Solstice)
73½°
Sunset 30° S. of W.
March 21st-22nd Sept. 22nd-23rd (Equinoxes)
52°
W.
Sunset 30° N. of W
28½°
June 22nd (Winter Solstice)
HORIZON
30°
73½°
30°
52°
28½°
S.
N.
30°
30°
HORIZON
E.
Sunrise due E.
Sunrise, Summer 30° S. of E.
Sunrise, Winter 30° N. of E.

Diagram showing the apparent path of the sun across the sky at different seasons of the year, as it appears in the latitude of Gisborne, that is, about 38½° S.

2. Now consider the conditions on June 22nd, the winter solstice. If the boy mentioned above were at the equator on that day the sun at noon would not be right over his head, but 23½° to the north; for its noon rays are then vertical at the Tropic of Cancer—the farthest position north of the equator at which they are ever vertical. The sun has then reached what astronomers call its **maximum north declination.**

If the boy, under the former supposition, were to travel south as before, the sun would be on the horizon when he reached 23½° degrees from the South Pole—that is, when he was at the Antarctic Circle, or in latitude 66½° south. If he went further south than this at that time, the sun would be below the horizon; for then he would be in the region of the long sunless Antarctic winter.

If our observations were made at Wellington, our inferences from them would be:—

Sun's noon altitude + Sun's north declination + our latitude = 90°.

(1) (June 22) $25\frac{1}{2}° + 23\frac{1}{2}° + x = 90°$.

$$\therefore x = 90° - 23\frac{1}{2}° - 25\frac{1}{2}°$$

$$= 41° = \text{(roughly) the latitude of Wellington}$$

(2) $\left\{\begin{array}{l}\text{March 22}\\ \text{Sept. 22}\end{array}\right\} 49° + 0° + x = 90°$.

$$\therefore x = 90° - 49° = 41° \text{ as before.}$$

If the observations were made on December 22nd (Summer Solstice) when the sun is vertical at the Tropic of Capricorn, 23° south of the equator (sun's maximum south declination) the sun's southern declination would have to be subtracted, thus:—

(3) Sun's noon altitude − sun's south declination + latitude = 90°.

(At Wellington, Dec. 22) $72\frac{1}{2}° - 23\frac{1}{2}° + x = 90°$.

$$\therefore x = 41° \text{ as before.}$$

3. To find the latitude of any school in New Zealand, therefore, we may measure the sun's noon altitude, at either the equinoxes or the solstices, and then proceed as indicated in the above illustrations or examples.*

13. THE INCLINATION OF THE EARTH'S AXIS TO THE PLANE OF ITS ORBIT.

1. We have seen that the sun's rays at noon are vertical (1) over the equator at the equinoxes

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*The latitude of a place may be found on any day when the sun is visible here, as its declination on that day may be found from a proper almanac.

(March 21st and September 23rd); (2) at the Tropic of Cancer (23½° North) on June 22nd, and (3) at the Tropic of Capricorn (23½° South) on December 22nd. We have also learnt that the axis of the earth always points in the same direction; and that the earth revolves round the sun, taking one year to perform the journey. The earth's path round the sun is called its **orbit** (Latin *orbis*, a circle). It is not a true circle, however, but an ellipse.

(1) Carry a small school globe round a table (on which is placed a lighted lamp to represent the sun) in such a way that the axis of the globe is tilted at an angle of 23½° from the vertical (or makes an angle of 66½° with the top of the table) and is always pointing in the same direction. In the successive positions in which the lamp flame is level with the Tropic of Cancer, the Equator, and the Tropic of Capricorn, respectively, note what part of the globe's surface is illuminated, and what part is in shadow, while the globe is rotated slowly from west to east.

(2) Again, carry the globe round the lamp (1) with its axis vertical, and (2) with its axis horizontal; and note that in (1) when the globe is rotated slowly the half of its surface (next the lamp) from pole to pole is illuminated at one time; and that in (2) the half from the pole (facing the lamp) to the equator is in constant light, while the other half from the equator to the remote pole, is in constant darkness.

(3) As it is only in the position first mentioned that we get the conditions which actually exist at both the equinoxes and the solstices, we may assume that the earth's axis is tilted towards the plane of its orbit at an angle of 66½°.

14. LENGTH OF THE DAY AT DIFFERENT SEASONS.

1. Using the globe, the lighted lamp, and the table, mentioned in the preceding section, set the globe as before in the positions for March 22nd or September 22nd (the equinoxes). Gum a small piece of white paper over the site of Wellington. On a piece of cardboard, somewhat wider than the

diameter of the globe, describe a circle whose radius is a little longer than that of the globe. With a pair of scissors cut out this circle from the centre of the cardboard, and slip the remaining rim of cardboard over the globe from pole to pole; thus dividing the illuminated portion of the globe (towards the lamp) from the darkened portion on the opposite side. This rim of cardboard, thus placed, we may call the "day and night circle."

2. Now slowly rotate the globe anti-clockwise, and observe that the piece of white paper at Wellington passes from the day and night circle through the illuminated portion of the globe to the opposite part of the day and night circle, underneath which it passes into darkness; and that this happens every time the globe is rotated once.

3. If the globe were the earth in the position it occupies in regard to the sun at either of the equinoxes, and the piece of white paper were a man, he would first see the sun east of him, and just on the horizon. This would represent sunrise. As the globe was slowly rotated he would see the sun rise higher and higher until it reached its highest point for that day. This would represent noon to the man. Later, as the globe continued its rotation, the sun would apparently descend in the sky until the man passed to the day and night circle. The sun would then be west of him on the horizon, and he would be passing into the circle of darkness, or night.

4. From illustrations such as this we see that the succession of day and night may be caused by the rotation of the earth on its axis from west to east; and that at the equinoxes, when the sun's noon rays are vertical at the equator, the man referred to,

whatever his position on the globe, would be within the circle of sunlight for 12 hours, and then within the circle of darkness for 12 hours. In other words, the day and night would be of equal length, at that time, all over the world.

5. Now move the globe round in an arc of a circle (keeping its axis always parallel to its original direction) so that the flame of the lamp will strike directly on the Tropic of Capricorn. Also shift the position of the day and night circle until one portion of the cardboard rim is on the Arctic Circle on one side and on the Antarctic Circle on the other side of the globe, the South Pole now being turned towards the lamp flame (the sun). The circle of light on the globe will now extend from the Arctic Circle on one side to the Antarctic Circle on the other side of the globe. Rotate the globe as before. Places between the Arctic Circle and the North Pole will remain in darkness, while those between the Antarctic Circle and the South Pole will remain within the circle of light, during the whole rotation. In other words, all places north of the Arctic Circle would have at least 24 hours' continuous darkness. while all places South of the Antarctic Circle would have at least 24 hours of continuous light.

6. Also observe that the man represented by the piece of paper at Wellington would be longer within the circle of light than within the circle of darkness. For him, therefore, the day would be more than 12 hours, and the night less than 12 hours in length.

7. If the globe be next placed so that the flame of the lamp is directly in line with the Tropic of Cancer, and it be again slowly rotated with the axis still parallel to its original direction, the South Pole will be turned away from the

lamp, and the conditions already described will be reversed. All places within the Arctic Circle will now be within the circle of light for at least 24 hours, and all places south of the Antarctic Circle will be within the circle of darkness for at least the same time. The man at Wellington, too, will be longer within the circle of darkness than within the circle of light during a complete rotation. That is, his day will be less than 12 hours, and his night more than 12 hours, in length.

8. The length of the day at Wellington (or at any other place) may be roughly measured in the following manner:—

Let the globe be placed, in relation to the lamp flame, in the proper positions successively for the equinoxes and the solstices. Let one pupil watch carefully from the position of the lamp flame when the piece of paper representing Wellington first comes into view and then disappears as the globe is slowly rotated. Let another pupil holding a pencil-point near the equator note in each case how many degrees of longitude pass under his pencil while the paper is in sight. Allow one hour for every 15°, and the result will give roughly the length of the day at Wellington, during the Equinoxes, the Summer Solstice, and the Winter Solstice respectively, or at any other place similarly marked and observed.

9. From these and similar observations and experiments we may infer that the causes of the variation in the relative lengths of day and night at the same place during different seasons of the year are:—

(1) The inclination of the earth's axis to the plane of its orbit.
(2) The rotation of the earth on its axis.
(3) The revolution of the earth round the sun.

15. LENGTHS OF DAY AND NIGHT AT THE POLES.

1. As indicated in the previous sections, place the globe in regard to the lamp flame in the position for September 22nd. Notice that the South Pole is just at the edge of the illuminated hemisphere. Carry the globe (with its axis tilted as before) around the lamp past the position for December 22nd until you come to that for March 22nd, stopping at intervals to rotate the globe on its axis. Observe that during the whole time the South Pole has been within the circle of light, it has been enjoying continuous daylight.

2. Carry the globe, tilted as before, still further on its revolution round the lamp past the position for June 22nd, until you come back to your starting point of September 22nd, stopping at intervals as before to rotate the globe on its axis. Observe that after March 22nd the South Pole passed into shadow, and remained in darkness until September 22nd. That is to say it experienced a continuous night of six months' duration. Observe also that if there were no inclination of the axis, the Poles would always be at the limit of daylight, so that from those points the sun would always be seen with half its disc above the horizon.

3. We may therefore infer that the causes of the six months' day followed by the six months' night at the Poles are,

(1) The inclination of the earth's axis.

(2) Its constant direction.

(3) The revolution of the earth around the sun.

16. THE SEASONS.

1. From what has been said in the preceding paragraphs, together with the explanations already given on pages 61 to 66 concerning radiation, and the effect of the inclination of the sun's rays, it is plain that, in New Zealand, **mid-summer**, or the **summer solstice**, occurs on the 22nd December in each year, when the sun's noon rays are vertical at the Tropic of Capricorn, and are therefore more nearly vertical in New Zealand than at any other time of the year.

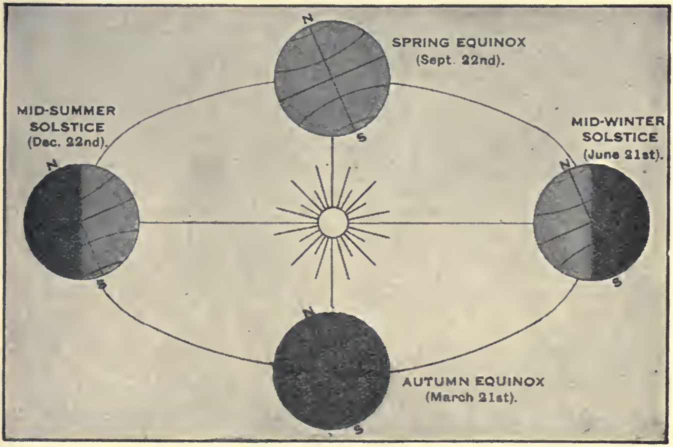


Diagram illustrating the Seasons. (Southern Hemisphere)

2. On the other hand **mid-winter**, or the **winter solstice**, will be when the sun's rays at noon are vertical at the Tropic of Cancer, and therefore strike New Zealand in a more slanting direction than at any other time of the year.

3. Similarly, mid-spring will occur on September 22nd, when the sun's rays are vertical at the equator,

and the sun is about to resume its journey towards the Tropic of Capricorn. This is the period of the **spring equinox.** The **autumn equinox,** on the other hand, occurs on March 22nd, when the sun's noon rays are again vertical at the equator, and the sun is, as it were, just about to continue his journey northwards to the Tropic of Cancer.

4. The diagram given on page 113 will illustrate this, and (with what has been already indicated) will help to show that the causes of the change of seasons as we have them in New Zealand are:—

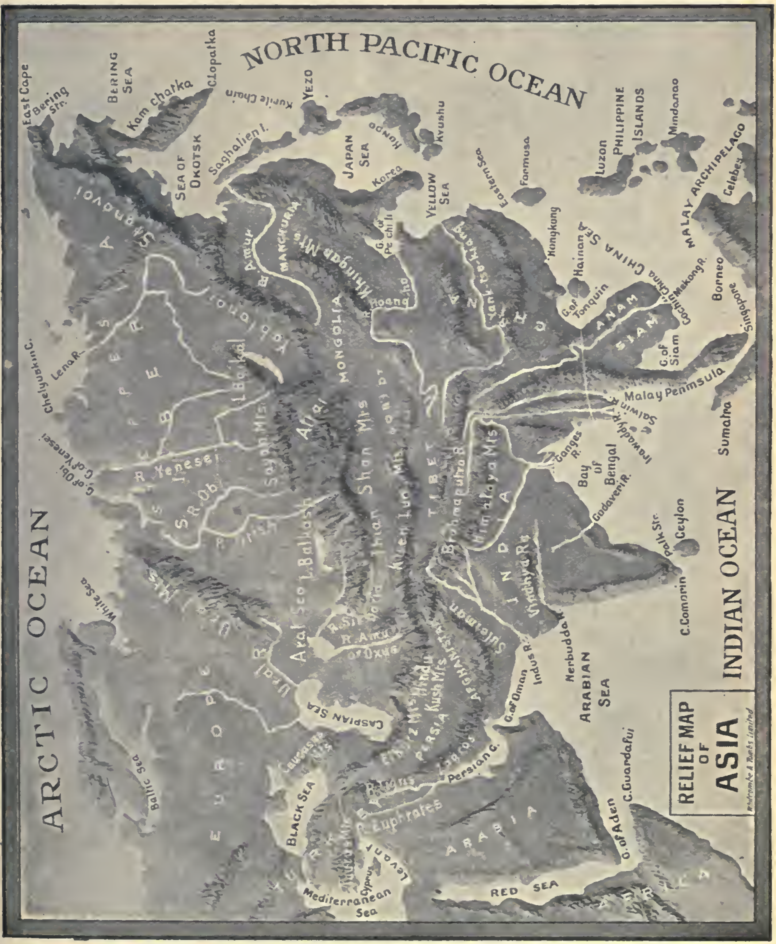
(1) The rotation of the earth on its axis.
(2) The revolution of the earth round the sun.
(3) The inclination of the earth's axis to the plane of its orbit.
(4) The constant direction or tilt of the earth's axis.

PART III.—ASIA AND AMERICA

1. ASIA.

1. Introductory.

1. **Asia** is the largest and the most elevated of the Continents. It is joined to Europe and Africa on the west, and reaches to within a few miles of North America on the east. It contains the highest mountains and the lowest depressions in the world. Stretching from near the Equator to beyond the Arctic Circle it possesses the greatest variety of climates and productions, and has areas of the greatest cold and the most intense heat. The most densely


RELIEF MAP OF ASIA
NORTH PACIFIC OCEAN
ARCTIC OCEAN
INDIAN OCEAN
East Cape
Bering Str.
BERING SEA
Kamchatka
C. Lopatka
Kurile Chain
YEZO
SEA OF OKOTSK
Saghalien I.
Stanovoi
JAPAN SEA
Hondo
Kyushu
Korea
YELLOW SEA
G. of Pe chi li
MANCHURIA
R. Amur
Khingan Mts
Hoang ho
Yablonoi
Eastern Sea
Formosa
Luzon
PHILIPPINE ISLANDS
Mindanao
MALAY ARCHIPELAGO
Celebes
Hongkong
Hainan
CHINA SEA
G. of Tonquin
Borneo
Mekong R.
Cochin China
ANAM
SIAM
G. of Siam
Singapore
Malay Peninsula
Sumatra
Salwin R.
Irawaddy R.
Ganges R.
Bay of Bengal
Godaveri R.
Palk Str.
Ceylon
C. Comorin
Yang tse kiang
Chelyuskin C.
Lena R.
L. Baikal
S I B E R I A
R. Yenesei
G. of Yenesei
G. of Obi
R. Ob
R. Irtish
Sayan Mts
Altai Mts
MONGOLIA
GOBI DT
Thian Shan Mts
Kuen Lun Mts
TIBET
Brahmaputra R.
Himalaya Mts
I N D I A
Vindhya Ra.
Nerbudda R.
Indus R.
Suleiman
AFGHANISTAN
Hindu Kush Mts
L. Balkash
Aral Sea
R. Amu or Oxus
R. Sir Daria
Ural R.
Ural Mts
CASPIAN SEA
Elburz Mts
PERSIA
Zagros
Persian G.
G. of Oman
ARABIAN SEA
C. Guardafui
G. of Aden
RED SEA
ARABIA
Euphrates
Tigris
Caucasus Mts
BLACK SEA
Taurus Mts
Cyprus
Levant
Mediterranean Sea
E U R O P E
White Sea
Baltic Sea
Andrews & Tubbs Limited

and the most sparsely populated countries are situated within its boundaries; while many different kinds of languages are spoken by its great variety of different peoples. The most populous parts of the British Empire are in Asia; the British sovereign ruling over more subjects in India than in all the other parts of his empire put together.

2. Contrasted with Europe.

Asia is five times as large as Europe. Its coast line is much broken by peninsulas and inlets, but not to the same proportionate extent as that of Europe. Both continents have large peninsulas running to the south—those of Spain, Italy, the Balkan Peninsula, and Scandinavia, in Europe, corresponding to Arabia, India, Further India, and Kamchatka, in Asia,—and a large archipelago to the southeast. In either continent the most important highlands and table-lands lie in the south, while the rivers run to all points of the compass. The surface of Europe is varied with hills, valleys, plains, and mountains; while that of Asia consists largely of vast and mountainous plateaus. The climate of the greater part of Europe is insular, as no part of it is very far away from the sea; that of Asia is for the most part continental. Europe may be easily traversed from north to south; Asia, only from east to west, as high tablelands make communication between north and south difficult.

3. Relief.

1. Asia is a region of great and lofty tablelands. About three-fourths of the continent is over 600 feet above sea-level, while about one-twelfth of it is over 10,000 feet high, culminating in Mt. Everest (over 29,000 feet), the highest mountain on the globe. The remainder of the continent consists of lowlands and depressions; the lowlands lying mainly in the north and west. The deepest inland depression in the world is the valley of the **Dead Sea**, which is more than a thousand feet beneath the surface level of the **Mediterranean**.

2. The surface of Asia may be divided into four different belts, varying according to their elevation. These are:—

(1) **The Northern Lowland**, a continuation of the great European Plain, stretching from the Caspian and the Ural Mountains to the Eastern Highlands. It consists of the **Plain of Turan** in the south, and the **Siberian Lowland** in the north.

"Along the Arctic Ocean extends the **tundra**,* where in spring the ice-bound rivers meet, and flood the surrounding country, adding to its desolation. South of the tundra are the forests, coniferous in the north, and mixed with deciduous woods in the south. South of the forest zone are steppe† lands, passing into desert in Turan."

(2) **The Central Mountains**, the loftiest and most extensive highlands in the world, consisting of three chains or groups running in an easterly-westerly direction. Of these, the northern chain is represented by the **Caucasus** and **Tian-Shan** Mountains, between which lie the great depressions of the Caspian and Sea of Aral basins. The central chain includes the Highlands of Armenia, the **Elburz** range, the **Hindu Kush**, the **Pamir** plateau, and the **Kuen Lun** mountains. The southern chain is represented by the **Taurus**, **Zagros**, and **Sulaiman** mountains, and the giant **Himalayas**. Between the central and southern chains lie the plateaus of Asiatic Turkey, Iran (Persia), and Tibet.

(3) **The Southern Tablelands** of Arabia, widening in the east to the plain of Mesopotamia; and the Deccan plateau in India, bounded by the fertile plain of the Indus and Ganges basins, and the Eastern and Western Ghats.

(4) The **Eastern Highlands**, represented by the **Altai**, **Yablonoi**, **Stanovoi**, and **Kingan** mountains.

(5) The **Eastern Volcanic Chain**, running through Kamchatka, the Kurile Islands, Japan, the Loo Choo Islands, and the Philippines.

"This chain is characterised by fertile soil, deep valleys, and steep conical mountains, of which Fujiyama, the sacred mountain of Japan, is the most perfect."

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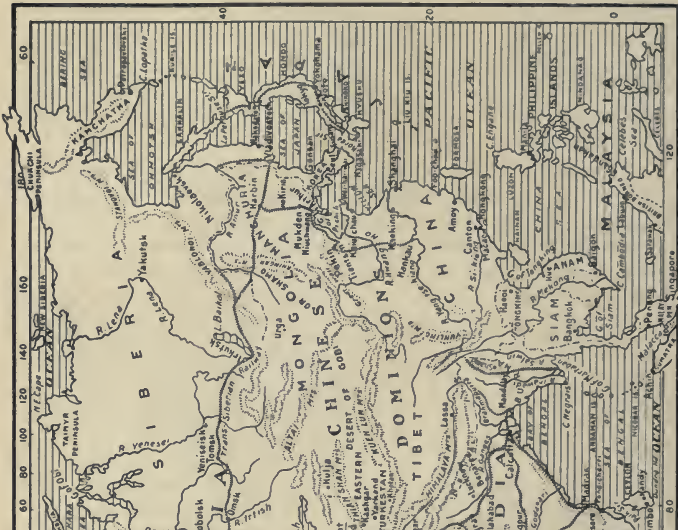
*Frozen swamp-lands of the north.

†Treeless, grassy plains or broad river valleys.


ASIA
MILES
RUSSIA
SIBERIA
EUROPE
CHINESE DOMINION
MONGOLIA
MANCHURIA
CHINA
TIBET
TURKESTAN
PERSIA
AFGHANISTAN
BALUCHISTAN
ARABIA
TURKEY
AFRICA
INDIA
SIAM
ANAM
MALAYSIA
PHILIPPINE ISLANDS
JAPAN
KAMCHATKA
ARCTIC OCEAN
ATLANTIC OCEAN
PACIFIC OCEAN
INDIAN OCEAN
ARABIAN SEA
BAY OF BENGAL
CHINA SEA
SEA OF JAPAN
SEA OF OKHOTSK
BERING SEA
CASPIAN SEA
BLACK SEA
MEDITERRANEAN SEA
RED SEA
Persian Gulf
G. of Oman
G. of Aden
DESERT OF GOBI
HIMALAYA MTS.
KUEN LUN MTS.
ALTAI MTS.
URAL MTS.
CAUCASUS MTS.
HINDU KUSH
R. Lena
R. Yenesei
R. Ob
R. Irtish
R. Volga
L. Baikal
L. Balkash
Sea of Aral
Trans-Siberian Railway
Petrograd
Moscow
Constantinople
Tomsk
Omsk
Irkutsk
Yakutsk
Urga
Peking
Shanghai
Canton
Hongkong
Lassa
Calcutta
Bombay
Madras
Delhi
Colombo
Bangkok
Saigon
Singapore
Manila
Mecca
Medina
Aden
Bagdad
Teheran
Tokyo
60
40
20
0
80
100
120
140
160
180

4. Rivers.

1. Asia is also a continent of great rivers. The longer streams have their sources in the great central tableland, and flow north, east, and south into the Arctic, Pacific, and Indian Oceans respectively. Some of the rivers do not reach an ocean but drain the great inland continental basin, and discharge their waters into the Caspian, the Sea of Aral, or some other inland stretch of waters.

From the central mountains and tablelands three large rivers, the **Lena**, the **Yenesei**, and the **Ob**, reach the Arctic Ocean, after draining the northern lowlands. These rivers are either ice-bound, or blocked with ice, for eight or nine months in the year. From the same lofty sources the **Amur**, the **Hoang-ho**, and the **Yang-tse-kiang**, draining the eastern valleys, reach the Pacific; while the **Salwin**, the **Irawadi**, the twin rivers **Brahmaputra** and **Ganges**, the **Indus**, and the twin rivers **Tigris** and **Euphrates**, reach different portions of the Indian Ocean. Draining the inland continental basin, the **Sir Daria**, and the **Amu** or **Oxus**, flow in a general northerly direction into the Sea of Aral, while the **Ural** River, flowing south from the Ural Mountains, reaches the Caspian Sea.

5. Deserts.

1. A striking feature of Asia is the great belt of deserts or very dry land, much of which is almost entirely rainless, which crosses the continent from the south-west to the north-east. This belt seems to be a continuation of the great Sahara Desert of Africa. It is partly due to the gradual elevation of the continent and to the present high average altitude of even comparatively level areas, such as those of Persia, India, China, Central Asia, and the areas between them.

The principal portions of this desert belt are—(1) the **Syrian Desert**, east of the Jordan valley; (2) the **Desert of Mesopotamia**, between the Tigris and Euphrates, once of great fertility, and probably destined to be so again now that it is under British occupation; (3) the **Great Arabian** Desert, in the south of Arabia, where in some places the sand is 600 feet deep; (4) the **Great Salt Steppe** of Persia; (5) the **Deserts of Makran** and **Seistan,** in the south-west of Afghanistan; (6) the **Thar,** the great sandy desert of northern India, east of the Indus Basin, and (7) the **Desert of Gobi** or **Shamo**—"a sweep of sandy wastes (interspersed, however, with mountain ranges, rich both in animal and vegetable life) which stretches continuously across 40° of longitude." Near the Sea of Aral are the deserts of Kara Kum and Kizi Kum.

6. Climate.

1. About three-fourths of Asia lies within the North Temperate Zone, the remainder of the continent being almost equally divided between the North Frigid and the Torrid Zones. The most southerly point of the continent almost touches the Equator, while the most northerly point is within a few degrees of the North Pole. According to elevation, the land of Asia rises from 85 feet below sea-level to nearly 30,000 feet above it. Hence very hot and very cold regions may be looked for. Again, the interior of the great compact land mass of the continent is far removed from the sea, so that a continental climate with great extremes of temperature may be expected.

2. From the great central table-lands the continent slopes towards the cold Arctic Ocean; that is, away from the sun, thus making the temperature of the northern regions much colder on the whole than it would be if the land sloped towards the sun.

Towards the south, when the sun crosses the Equator on its apparent journey towards the Tropic of Cancer, the great Tableland of Tibet becomes increasingly heated; the air over it becomes warmer and lighter, and is displaced by the colder and heavier air from other quarters. The indraught of cold air becomes so strong that the North-east Trades are turned completely round and converted into south-west winds, known as seasonal winds or **monsoons**. The North-east Trades blow in the northern winter from October to March; the South-west Monsoons from April to September.

3. Three main climatic regions may accordingly be distinguished:—

(1) **The South-eastern Region**, extending from the Indus Basin to Japan, where the average annual temperature is always high. Here, the cold winds from the high central tablelands are shut off from the southern lands by the mountain chains, while the nearness of the sea ensures an equable temperature, and a sufficient rainfall.

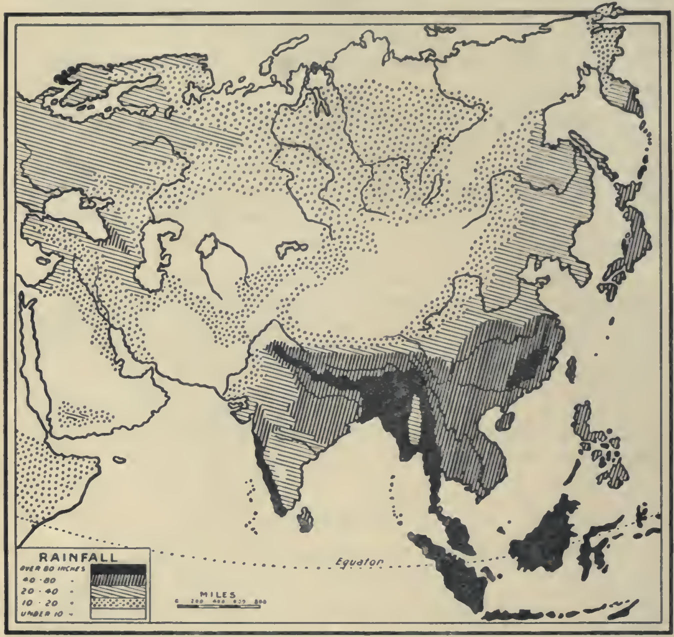
(2) **The Region of the Tablelands**, stretching from the Mediterranean to the Pacific. Here, the mountains shut off the rain-bearing winds from the Indian Ocean; and the winds from Africa are dry winds, bringing little moisture to south-western Asia.

(3) The cold **Northern Region**, where in some parts there is a difference of 100° Fahrenheit between the summer and winter temperatures.

7. Rainfall.

1. The reasons for the varieties of climate in Asia, given above, also to some extent account for the differences in rainfall of various regions. The rainfall map on the next page shows that only a margin of the continent, from Kamchatka to the Indus, has an average annual rainfall of over 20 inches.

The greater part of the continent receives very little rain. In winter, when the land is on the whole cooler than the sea, the winds blow from the interior of the continent towards the ocean, so that comparatively little rain falls during that season except round the Mediterranean, and along the coastal lands of the east. During the summer, except in the Mediterranean region, moisture-laden winds drive in from the sea, making summer the wetter season. Most of the moisture from the Indian and Pacific Oceans is shed on the southern and eastern slopes of the central and eastern mountain systems, very little of it reaching the interior in the form of rain. Central Australia may be compared with Central Asia in these respects.



Rainfall Map of Asia.

8. The Different Races of Asia, and their Relatively Backward Condition.

(1) The peoples of Asia belong, for the most part, to two great races—the **Mongolian**, or yellow type, numbering about seventy per cent. of the total population, and the **Caucasian**, or white type. Of the minor races, the **Malay** is the most important.

(2) The mountain ranges stretching from the Caspian Sea to the Himalayas roughly separate the lands peopled by the Mongolians and Caucasians respectively. The Mongolians, of whom the Chinese are the most numerous, live mainly to the north of this line; while the Caucasians inhabit the countries to the south of it—the peoples of India forming the most numerous group.

(3) Asiatics stand on a higher level than the native races of Africa or America, but are not reckoned so civilised as those of western Europe. In the past, they were to some extent regarded as mere members of a family or religion over which the chief or ruling authority had absolute sway, and controlled the rights and destinies of the people. They, therefore, have not as yet acquired the same sentiment of independence and freedom as Europeans, and are more content than the latter to live and act as their fathers lived and acted, instead of trying to find out and practice better modes of life for themselves. The consequence is that they have not made the progress in civilisation (that is, in art, in literature, in science, and in general conduct) that the best Europeans have made.

The Japanese, and the better class of Chinese, are to some extent exceptions to this rule, as of late years they have been eager to absorb Western ideas—particularly in regard to military, naval, commercial, and industrial matters.

The majority of the people who live in Europe, North and South America, Australia, and New Zealand belong to the Caucasian race.

(4) Asia is the cradle of the great religions of the world—Christianity, Buddhism, Mohammedanism (Islam). There, popular government, as we understand it, is almost unknown; a revolution merely means a change of dynasty. History shows us that progress is most rapid when it is accompanied by a migration of races, or in the transplantation of ideas and institutions. Owing to the absence of these conditions, progress in Asia (except in the cases mentioned above) has been almost insignificant. The maritime nations (Britain, France, etc.), and Russia (through her control of Siberia), have, however, had considerable influence in promoting the progress of the Asiatic people.

9. The Chief Countries of Asia.

Besides the **Indian Empire*** and other British territory in Asia, the chief countries of importance to the British people are **Asiatic Russia, China, Asiatic Turkey, Persia, Afghanistan, Arabia, Japan†**, and the **Malay Archipelago.**

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*India is dealt with on pages 198-209. †and Japan on pages 224-227

1. ASIATIC RUSSIA.

Asiatic Russia includes certain countries that belong to the **Russian Union** or Union of Socialist Soviet Republics, which comprises Soviet Russia (capital Moscow), the Ukraine, and White Russia in Europe, as well as **Transcaucasia, Turkmenistan, Uzbekistan, Tajikistan, Siberia, Mongolia** in Asia.

1. **Transcaucasia.**—This is a federation of three Socialist Soviet Republics:

Republic	Sq. mi.	Population.
Armenia	15,000	1,300,000
Georgia	25,500	2,100,000
Azerbaijan	33,500	2,500,000
	74,000	5,900,000

(*a*) **Armenia** comprises territory formerly shared by Turkey, Russia, and Persia, whose inhabitants were the earliest Christians. It has fertile valleys and plains, producing cereals, cotton, rice, flax, and tobacco. The country is rich in minerals which have been as yet hardly developed. The capital is **Erivan** (90,000).

(*b*) **Georgia**, lying between Armenia and the Caucasus Mountains, produces oil, manganese, wine, and tobacco. Its Black Sea port of **Batoum** is connected by petroleum pipe line with Baku, on the Caspian, in Azerbaijan. A railway also connects Baku with its ports **Batoum** and **Poti** *viâ* the capital, **Tiflis** (400,000), which is the chief town in Transcaucasia.

(*c*) **Azerbaijan**, lying to the south-west of the Caspian Sea, is famous for its oil wells, which occur in the Baku region. It is, however, mainly and agricultural country. Its capital is **Baku** (447,000) on the Caspian Sea.

2. **Turkmenistan** (965,000) lies east of the Caspian Sea and north of Persia. The main occupation of the people is agriculture. The present capital is **Poltarask**, pending removal to Leninsk (20,000). Another centre is **Merv** (15,000), while **Krasnovodsk** is a port on the Caspian and a terminus of the Trans-Caspian railway.

3. **Uzbekistan** (4,000,000) lies to the east of Turkmenistan and north of Afghanistan, and includes lands formerly in-

cluded in Turkestan, Bokhara, and Khorezm (or Khiva). The chief products are rice, wheat, fruit, hemp, cotton, silk, and carpets. Postal air-lines connect certain important centres. The capital is **Samarkand** (100,000); other towns are **Tashkent** (245,000), **Bokhara** (75,000), and **Khiva** (10,000).

4. **Tajikistan** (700,000), a backward region occupied by a farming and cattle-breeding population. The capital is **Dushambe**, which is linked by air-line with other centres.

5. **Siberia** is a vast region divided among the governments of Tobolsk, Tomsk, Yenesesisk, Irkutsk, and Yakutsk, as well as a number of smaller provinces, all of which acknowledge the authority of the Russian Soviet government at Moscow. The relief of the country has been described on page 117. The chief products are cereals and animal products, while the principal means of transport is the Trans-Siberian railway.

6. **Mongolia**, formerly part of the Chinese Empire, became a protectorate of the Russian Union in 1924, though Soviet Russia may agree with China to withdraw from the region. Its area is about 1,360,000 square miles, and its population over 3,000,000, is largely nomadic.

North-West (or Outer) Mongolia is a well-watered plateau which provides excellent pasture for cattle and sheep, and particularly for transport animals (camels and oxen). The capital is **Urga**.

Inner Mongolia includes the Gobi or Shamo Desert, which covers nearly one-third of its area. In the region bordering China the pastoral industry prevails, though there is some agriculture, particularly where Chinese are settled. The population is chiefly centred in towns controlling the caravan routes between China and Siberia. During summer months motor-car services cross the Gobi desert.

2. CHINA.

1. Area and Population.

The Chinese Republic is the most populous and, excluding Siberia, the largest country in Asia. It consists of China Proper and the dependencies of Manchuria, Inner Tibet, and Chinese Turkestan. Its area is nearly four million square miles, and its population is estimated at over 480 millions. Though the civilization of China is very ancient and the people are industrious and peace-loving, they are conservative and unprogressive. Thus they have lagged far behind the Japanese in the adoption of Western ideas.

2. Government.

A revolution in February, 1912, overthrew the monarchy which had existed for many centuries, and a republican government was set up at Peking. This, however, did not please all classes, and a strong nationalist party, which grew up in the south adopted as its watchword "China for the Chinese," and began a violent agitation for the expulsion of all foreigners from the country.

For several years civil war has been waged between Northern and Southern Chinese armies, resulting in much bloodshed and widespread misery. At present the Southerners are in possession of the whole of Southern China as far north as Hankow and Nanking, their progress northward is likely to be checked by disunion within their ranks. Meanwhile foreign powers, including Great Britain, have naval and military forces at Shanghai and Hankow, in readiness to protect the Consulates and European lives and property, if necessary.

3. Products and Industries.

(1) **Agriculture** is the main industry. The land is all freehold, held by families, in small areas, on the payment of an annual tax. **Rice** is the principal article of food in the centre and south, and **millet** in the north. The soil being fruitful and well-watered, large crops are produced. **Wheat, barley,** and **maize** are also grown, chiefly in the north; while **sugar** and **indigo** are produced in the south. **Cotton, tobacco,** and **fruit** are also largely grown. The production of **tea** and **silk** in large quantities is noteworthy.

The manufactures of **cottons, silks, woollen goods,** and **porcelain** are extensive.

The largest and richest **coal-fields** in the world occur in China, and **iron ores** are abundant, though almost undeveloped.

4. Chief Towns.

(1) There are many large and populous towns in China, the principal being **Peking** (1,300,000) the capital; **Hankow** (290,000); **Canton** (1,370,000); **Tientsin** (838,000), the port of Peking; and **Shanghai** (1,600,000).

3. ASIATIC TURKEY.

The defeat of Turkey in the Great War of 1914-18 led to the break up of the old Ottoman Empire by the formation of several new states and mandated territories. Thus the kingdom of **Iraq** (Mesopotamia) and **Palestine** are under British mandates, and **Syria** is under French rule, while **Armenia** is an independent republic. A rich district in the west of Asia Minor, including the chief town **Smyrna** (99,000), placed by the League of Nations under Greek administration in 1920, was in 1922 overrun and re-occupied by Turkey with much bloodshed and cruelty. The coastal area of the Dardanelles, the Sea of Marmora, and the Bosphorus including the port of **Scutari,** comprises a region termed the **Zone of the Straits,** which is under Turkish rule for all except military purposes.

In 1923 Turkey (European and Asiatic) became a republic, and **Angora** (65,000) was declared to be the capital. The area of the republic is about 495,000 sq. miles, and its population is about 13 millions, of whom 12 millions live in Asiatic Turkey. The towns next in importance to Smyrna are **Konia** (71,000) and **Brusa** (65,000). The latter is the centre of a silk-producing district, and its chief port is **Mudania**.

The chief products are tobacco, mohair, cereals, fruits, and silk.

4. PERSIA.

Persia is of importance to Great Britain on account of its nearness to our Indian Empire, and to the fact that it is to some extent under British supervision. Its rich oil-fields (petroleum) are under British control. Its **area** is about 628,000 square miles, a large portion of which is an absolute desert. Its **population** is about 12,000,000.

The principal towns are **Teheran** (350,000), the capital; **Tabriz** (180,000), the chief commercial town; and **Bushire**, on the Persian Gulf, the chief port.

The products are petroleum, wheat, barley, rice, fruits, wine, gums, opium, wool, cotton, silk, and hand-made carpets.

5. AFGHANISTAN.

Afghanistan is of importance to the British as it separates North-western India from Central Russia. Its **area** is about 245,000 square miles, and its **population** is estimated at some twelve millions.

The capital is **Kabul** (100,000).

6. ARABIA.

Arabia, a large peninsula in south-west Asia, a great part of which is desert, has an **area** of about 1,000,000 square miles, and a **population** approaching 10,000,000. Until 1916 Arabia formed part of the Turkish Empire, but in that year the Arabs in the provinces of Hejaz and Yemen declared their independence. Two other important states are Nejd and Oman.

The chief towns are **Mecca** (70,000) and **Medina**, the Holy Places of the Mohammedans.

Important products are dates, and coffee.

For **India** and other British possessions in **Asia,** see pages 198-209. For **Japan,** see pages 224-227.

7. THE MALAY ARCHIPELAGO.

The **Malay Archipelago**, situated between Asia and Australia, contains the two largest islands in the world (**New Guinea** and **Borneo**). The islands are chiefly under the control of other countries:—

1. **Great Britain**—North-western **Borneo** and **Labuan.**
2. **The United States of America**—The **Philippines.**
3. **Portugal**—Part of **Timor.**
4. **Holland**—**Sumatra, Java,** two-thirds of **Borneo,** the lesser **Sunda** Island, and the **Moluccas.**

2. NORTH AMERICA.*

1. Introductory.

North America is a continent of long and lofty mountain chains, vast plains, great rivers, and large lakes. Its **area** is less than half that of Asia. It is joined to South America by the Isthmus of Panama, now intersected by the Panama Canal.

2. Compared with South America.

(1) Both continents are roughly of triangular shape, broad towards the north, and tapering to a point in the south. The east coast of each is generally low, and is fringed with narrow islands, while the western shores are high with few ocean inlets. A long and lofty mountain system runs along the west coast of both continents, while a smaller mountain system lies near the eastern shores of each. Vast plains, extending from north to south, occupy the interior of each. Both continents have great rivers, somewhat resembling each other in size and direction; *e.g.*, in North America the St. Lawrence, flowing from west to east, and the Mississippi from north to south, may be compared with the Amazon and the La Plata of South America, flowing in similar directions.

3. Relief.

The **Great Central Plain**, containing the valleys of the Mississippi, Red River, and the **Great Lakes**, stretches from the Arctic Ocean to the Gulf of

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*For Relief Map of North and Central America see facing page 160.

Mexico, and lies between the Western Mountain System, of which the Rocky Mountains is the chief chain, and the **Appalachian** or **Alleghany Mountains** on the east. It consists of highly fertile prairie lands.

4. Rivers.

The principal rivers are the **Mississippi** and its tributaries, flowing south into the Gulf of Mexico; the **Mackenzie**, draining lakes Great Bear, Great Slave, and Athabasca, and flowing north into the Arctic Ocean; the **St. Lawrence** (the overflow of the **Five Great Lakes** of **Superior, Huron, Michigan, Erie**, and **Ontario**), flowing east into the Atlantic (Gulf of St. Lawrence); the **Nelson** or **Saskatchewan,** reaching Hudson Bay; and (reaching the Pacific) the **Colorado, Columbia, Fraser** or **Peace**, and **Yukon.**

5. Climate and Rainfall.

1. North America stretches from about 10° south of the Pole to within 10° of the Equator. At sea-level, therefore, it possesses every gradation of climate from Arctic to tropical, but, on the whole, its climate is colder than that of corresponding latitudes in Europe.

Labrador (latitude of Great Britain) is colder than Siberia; Quebec (latitude of Paris) has a much colder and longer winter than Paris, and a shorter and warmer summer. At Washington (latitude of Sicily) the River Potomac is frozen over in winter, and sleighs glide along the snow-covered, frozen streets, while Sicily has a genial climate even in winter.

2. The reasons for this difference of climate are not difficult to understand:—

(1) Winds blowing across warm seas are warmer, and contain more moisture than those blowing across colder

seas. Through Bering Strait flows a cold, icy current from the Arctic regions, making the Alaskan coast and part of the western sea-board of Canada extremely cold in winter. Similarly, a polar current washes the eastern shores of Labrador; while the warm waters of the Gulf Stream reach the western shores of Europe. Again, the warm Japan Current strikes the Californian coast, making that portion of the United States warmer than the eastern shores cooled by the cold polar current.

(2) The long mountain barrier of the Rockies intercept the moisture-laden winds from the Pacific, while the absence of high barriers in the east gives full play to the easterly winds from the Atlantic.

(3) In North America the general slope of the land is towards the Pole; in Europe it is towards the Equator.

(4) The absence of great inland seas helps to make North America colder than Europe.

(5) For the reasons stated, the **rainfall** is heavier on the western coastal lands than in the east. It is greatest in the south, where the winds blow from the warm Gulf of Mexico.

6. The Chief Countries of North America.

The chief countries of North America are the **Dominion of Canada, Newfoundland**, the **United States of America, Mexico**, the **Central American Republics**, and the **West Indies**. Of these, the British Possessions (Canada, Newfoundland, and the British West Indies) are dealt with on pages 162-180, and the United States on pages 216-224.

1. MEXICO.

Mexico is a Federal Republic lying between the United States and the Central American Republics. Nearly half the people are of pure Indian blood; the bulk of the remainder being of mixed Spanish and Indian descent. The chief **industries** comprise the mining and smelting of silver, copper, lead, zinc, etc., cotton manufacture, agriculture, and cattle herding. The Mexican petroleum wells are exceedingly valuable, the production exceeding 115 million barrels.

Mexico has an **area** of nearly 800,000 square miles, and a **population** of about 14,000,000. Its capital and chief town is **Mexico** (1,180,000).

2. CENTRAL AMERICA.

Central America consists of the Republics of **Guatemala, San Salvador, Honduras, Nicaragua** and **Costa Rica**; and the British Colony of **British Honduras.** The dominant race is of mixed Spanish and Indian blood, the prevalent language being Spanish, as in Mexico. The chief **productions** are **coffee, cocoa, sugar, indigo, tobacco, rubber, tropical timbers**, and **bananas.**

3. THE WEST INDIES.

1. The islands of the **West Indian Archipelago,** lying between North and South America in warm and sunlit seas, are in the main very fertile. Most of them grow **sugar** and **coffee**, the **cotton-tree**, the **cacao** plant (from which **cocoa** and **chocolate** are made), and **tobacco**; as well as such fruits as the guava, pineapple, pomegranate, orange, lemon, and banana. Some of them also produce **timber** —especially mahogany, teak, rosewood, and sandalwood.

(1) Most of the West India Islands belong to European Powers; Britain holding **Jamaica, Trinidad, Barbados,** the **Bahamas, Bermuda,** and a few others.* The United States possesses **Porto Rico,** and controls the nominally independent republic of **Cuba.**

(2) The island of **Hayti,** the population of which consists mainly of negroes and mulattoes, is divided into two States —the negro **Republic of Hayti,** and the mulatto **Republic of San Domingo.**

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*See page 179.

3. SOUTH AMERICA.*

1. Introductory.

South America is somewhat similar to North America in shape and size, and in the arrangement of its mountain systems. Its **area** is about 7,000,000 square miles, or about 2⅓ times that of Australia. It extends from 12½° north latitude to about 54° south latitude; that is, it stretches over 66° of latitude. The great bulk of the continent lies within the tropics.

2. Relief.

1. The lofty chain of the **Andes** mountains extends along the whole of the western coast line. From there the country has a gradual slope to the east, forming vast plains intersected by great rivers. The **highlands** of **Venezuela** and **Guiana**, in the north, separate the basin of the **Orinoco** and the rivers of Guiana from the mighty basin of the **Amazon**. The **highlands of Brazil**, bordered on the east by a narrow coastal strip, include a large extent of hilly country.

2. The **plains** of South America, known under various names, are noteworthy.

(1) The **Llanos** are broad plains occupying the Orinoco basin. After the rainy season they are covered with luxuriant grasses and flowers, but become parched in the dry season.

(2) The **Selvas**, or wooded plains of the Amazon Basin, are covered with almost impenetrable tropical forest through which the great tributaries of the Amazon wind their way.

(3) The **Pampas** are treeless, grass-covered, level plains lying between the Andes and the river Parana.

3. Rivers and Lakes.

Owing to the great mountain backbone of the Andes lying so near the west coast, all the larger rivers flow towards either the northern or the eastern shores of the continent. Of these, the largest are the **Orinoco**, the **Amazon** (which provides 50,000 miles of waterways), and the **La Plata**, formed by the junction of the **Parana** and its main tributary the **Paraguay**, with the **Uruguay**.

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*For Relief Map of South America see facing page 160.

There is a remarkable absence of **Lakes** in South America. **Lake Maracaybo,** which is really a lagoon, joins the Gulf of Maracaybo in the north. **Lake Titicaca,** on the dry tableland of Titicaca, enclosed by the Central Andes, is nearly 13,000 feet above sea-level.

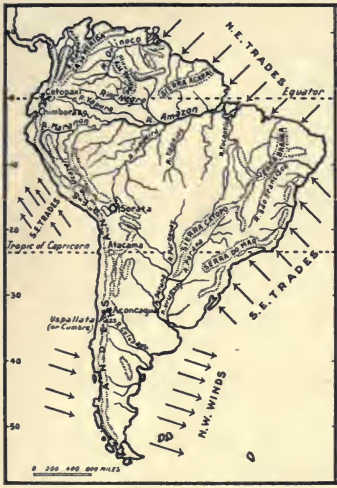
4. Climate and Rainfall.

1. As about four-fifths of the surface of the South American continent lies within the tropics, and the greater part of that area is of moderately low altitude, the **climate** there is tropical, with alternate wet and dry seasons. The **rainfall** is mainly determined by the long and lofty mountain chain of the Andes, by the mountains of Ecuador, Guiana, and Brazil, and by the north-east and south-east **trade-winds**.

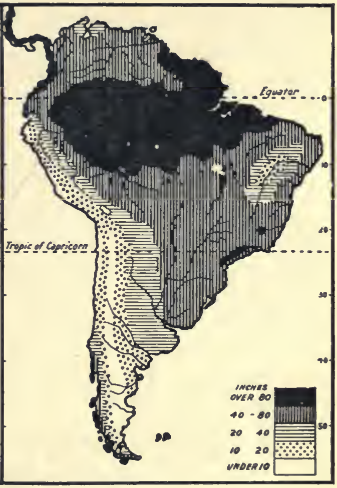
(1) The warm vapour-laden **North-east** and **South-east Trade winds,** blowing from the vast Atlantic, cross the South American continent at right angles. They are driven into the upper regions of the atmosphere by the mountains of Venezuela and Guiana, and those of Brazil respectively. The expansion that occurs where they meet, high over the Amazon Valley causes a drop in temperature, which condenses this vapour into floods of rain. Hence we have the largest river, and also the largest and most luxuriant forest area, in the world; as, under the vertical sun, heat and moisture combine to promote the most luxurious plant growth. These winds, crossing the continent, are driven still higher into the air by the lofty Andes, and there part with the rest of their moisture.

(2) The northern section of the Andes has abundant rain on both sides, as there the great mountain chain is lower in altitude than in the central section, and westerly winds from the Pacific also prevail. South of the Amazon basin the greater part of the moisture from the south-east trade winds is shed on the Brazilian mountains, hence the

Campos of Brazil and the partially salt plains of **El Gran Chaco** have a scanty rain supply; while the western side of the Andes, in the same latitude, is particularly dry, especially the **Desert of Atacama**, in Chile. South of the latitude of 30° S. the prevailing winds from the Pacific are westerly, "the roaring forties." These bring rain to Western Patagonia; while the eastern plains, the **Pampas** and **Steppes** of Patagonia are dry.



Mountains, Rivers and Winds of South America.



Rainfall Map of South America.

5. Chief Countries of South America.

1. South America was colonised chiefly by the Spanish and Portuguese. The bulk of the people are of mixed Spanish and Indian blood. The continent is rich in **minerals**; **gold**, **silver**, and **diamonds** being the most valuable. **Coffee**, **sugar**, **tobacco**, **cotton**, **rubber**, and other tropical products are in abundance. **Cattle** and **sheep** are reared in great numbers — particularly in the **Argentine**, which country is a strong competitor of Australia and New Zealand in the production of chilled beef, frozen mutton, and wool.

2. The countries of South America, with their areas, populations, and capitals, are given in the following table. All are **republics**, with the exception of the British, French, and Dutch Colonies of Guiana :—

Country	Area in sq. miles	Population	Capital
Brazil	3,298,000	32,000,000	Rio de Janeiro (1,150,000)
British Guiana	90,300	304,000	Georgetown (56,000)
Dutch Guiana (*Surinam*)	54,000	139,000	Paramaribo (45,000)
French Guiana (*Cayenne*)	34,000	44,000	Cayenne (10,000)
Venezuela	400,000	2,500,000	Caracas (92,000)
Colombia	440,000	6,900,000	Bogota (166,000)
Ecuador	220,000	2,000,000	Quito (80,000)
Peru	532,000	5,550,000	Lima (190,000)
Bolivia	514,000	3,000,000	La Paz[*] (118,000)
Chile	290,000	3,950,000	Santiago (507,000)
Argentine Republic	1,153,000	10,000,000	Buenos Ayres (2,300,000)
Uruguay	72,000	1,677,000	Monte Video (430,000)
Paraguay	62,000	1,000,000	Asuncion (100,000)

PART IV.—THE BRITISH EMPIRE.

1. THE UNITED KINGDOM OF GREAT BRITAIN AND IRELAND.

1. Situation, etc.

1. The **United Kingdom**[†] **of Great Britain and** Ireland is generally referred to by Foreign Powers, or in treaties made with Foreign Powers, as **Great Britain.** It consists of the large island of Great Britain, divided politically into **England, Wales,** and **Scotland**; the smaller island of **Ireland,** and about 800 small islands and islets, most of which are dotted along the western shores of the mainland of Scotland.

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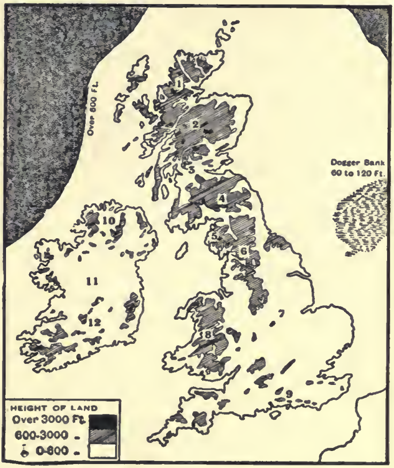
[*] Bolivia periodically changes its capital

[†] With the establishment of the Irish Free State in 1922 this term will no longer be appropriate and may fall into disuse.

2. The British Isles are separated by shallow and comparatively narrow seas from the continent of Europe, and form part of its north-western continental shelf. If the beds of these seas were elevated 600 feet, the United Kingdom would form part of the north-western Lowlands of continental Europe; that is, the islands would be joined by continuous land to Denmark, Holland, Belgium and Northern France, as was probably the case long ages ago.

3. If, on the other hand, the level of the sea were to rise 600 feet, all the white area shown on the map on this page would be covered with water, leaving only the shaded and black portions as dry land; while if the sea were to rise 3,000 feet, only the black portions shown on the map would be above sea-level.



The map, therefore, gives an indication of what portions of the British Isles consist of lowlands (under 600 feet), highlands (between 600 and 3,000 feet), and mountain tops (above 3,000 feet).

2. Surface of British Isles.

1. The general nature of the surface of the **United Kingdom** is roughly indicated on the map given above and on that on page 140; and it is also shown

on the relief maps of England, Scotland, and Ireland given on pages 149, 151, and 152. The latter afford a sort of bird's-eye view of the appearance of each country in regard to its mountains, lakes, and plains.

England.

1. The contour map of the British Isles shows that England is mountainous in the north and west; hilly in the central and southern counties; and flat and of low elevation in the east. Two-thirds of the total area may be classed as lowland country, consisting of three large plains: an **eastern** plain, a **central** plain, and a **western** plain.

2. Its **highlands** may be arranged in the following groups:—

(1) The **Pennine Range,** in the north.

(2) The **Cumbrian Group,** in Cumberland and Westmoreland; highest peak Scafell (3,208 ft.).

(3) The **Cambrian System** in Wales; highest peak, **Mt. Snowdon** (3,570 feet), the highest mountain in South Britain.

(4) The highlands of **Cornwall** and **Devon** in the Southwest.

3. **Rivers.**—The watershed of England lies nearer to the west coast than to the east coast; hence the eastern plain has a long, gentle slope towards the North Sea, into which the eastern rivers flow. Several of these are great commercial rivers, with slow currents, broad mouths, high tides, and no bars at their mouths. The chief rivers of this system are the **Tyne**, the **Wear**, the **Humber**, and the **Thames** (215 miles long).

The western slope of England is short and abrupt, leading to the Irish Sea, St. George's Channel and the Bristol Channel. The principal rivers of this slope are the **Mersey**, the Bristol **Avon**, and the **Severn** (240 miles long), which owes its length to its circuitous course.

The southern slope of England is also short, and the rivers flowing down it are consequently short, shallow, and of little commercial importance, the most important being the **Tamar**, the **Exe**, and the Salisbury **Avon**.

4. **Lakes.**—The lakes of England are noted for their quiet beauty, but they are few in number. They lie almost wholly in the "Lake District," situated in the mountainous north-western country, made famous by Wordsworth and the Lake School of poets, the principal being **Windermere**, **Ulleswater**, **Thirlmere**, and **Derwentwater**.

Scotland.

1. Scotland is on the whole a mountainous country, consisting for the most part of "a northern mountain-mass, a lowland plain, and a southern region of uplands." The general direction of the ranges is from the high west to the lower east. The only plain of importance is the Central **Lowland Plain** lying between the Grampians and the Southern Uplands, which includes Strathmore, or the Great Valley.

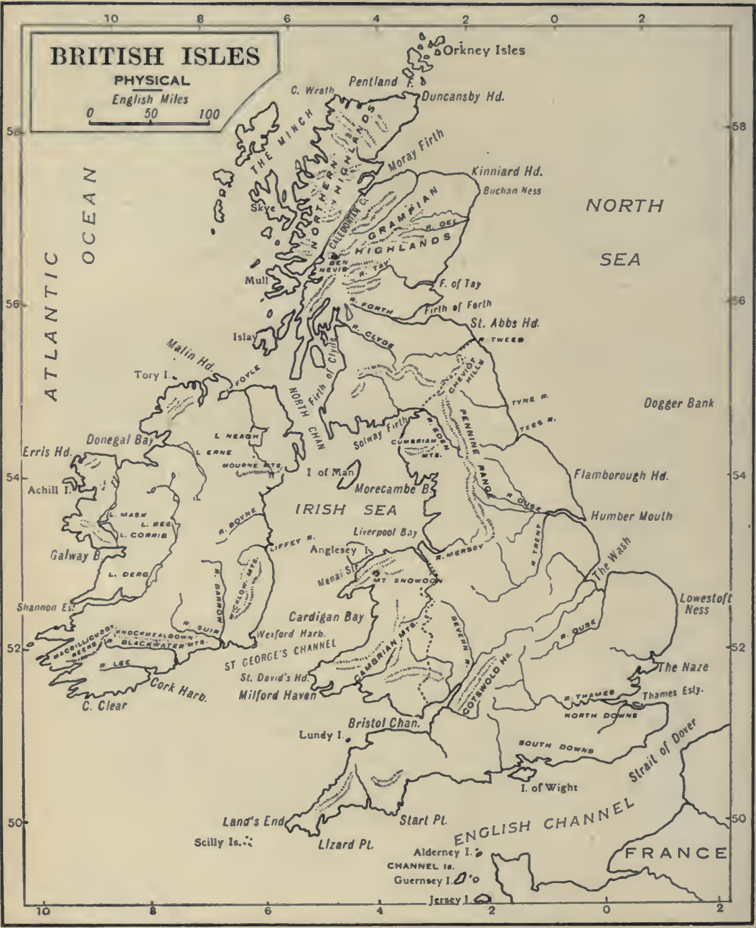
2. Three main mountain systems may be distinguished:—

(1) The **Northern Highlands**, lying to the north of the great glen, Glenmore, through which the Caledonian Canal runs from the Moray Firth to the West Coast.

(2) The **Grampian Highlands**, south of the Caledonian Canal, stretching from the coast of Aberdeen to Argyleshire. The chief peak (the highest in Britain) is **Ben Nevis**, 4,406 feet high.

(3) The **Southern Uplands**, the chief ranges of which are the **Lowther** and **Cheviot Hills**.

3. **Rivers.**—The main **watershed** of Scotland lies near the west coast, and runs in a northerly and southerly direction. The rivers running down the eastern slope are therefore much the longer, the


BRITISH ISLES
PHYSICAL
English Miles
0
50
100
10
8
6
4
2
0
2
58
56
54
52
50
ATLANTIC OCEAN
NORTH SEA
Orkney Isles
Pentland F.
C. Wrath
Duncansby Hd.
THE MINCH
NORTHERN HIGHLANDS
Moray Firth
Kinniard Hd.
Buchan Ness
Skye
CALEDONIAN CL.
GRAMPIAN HIGHLANDS
R. DEE
BEN NEVIS
R. TAY
Mull
F. of Tay
R. FORTH
Firth of Forth
St. Abbs Hd.
R. TWEED
Islay
R. CLYDE
Firth of Clyde
CHEVIOT HILLS
Malin Hd.
Tory I.
FOYLE
NORTH CHAN
TYNE R.
Dogger Bank
TEES R.
Solway Firth
CUMBRIAN MTS.
R. EDEN
PENNINE RANGE
L. NEAGH
Donegal Bay
L. ERNE
MOURNE MTS.
Erris Hd.
I of Man
Morecambe B.
Flamborough Hd.
Achill I.
R. OUSE
IRISH SEA
Humber Mouth
L. MASK
L. REE
L. CORRIB
R. BOYNE
R. TRENT
Liverpool Bay
LIFFEY R.
Anglesey I.
R. MERSEY
The Wash
Galway B.
Menai St.
MT SNOWDON
L. DERG
R. BARROW
WICKLOW MTS.
Lowestoft Ness
Shannon Es.
Cardigan Bay
R. SUIR
KNOCKMEALDOWN
MACGILLICUDDY'S REEKS
BLACKWATER MTS.
Wexford Harb.
R. OUSE
SEVERN R.
CAMBRIAN MTS.
ST GEORGE'S CHANNEL
R. LEE
COTSWOLD HS.
The Naze
St. David's Hd.
Cork Harb.
Milford Haven
Thames Esty.
R. THAMES
C. Clear
Bristol Chan.
NORTH DOWNS
Lundy I.
SOUTH DOWNS
Strait of Dover
I. of Wight
ENGLISH CHANNEL
Land's End
Start Pt.
Scilly Is.
Lizard Pt.
Alderney I.
FRANCE
CHANNEL Is.
Guernsey I.
Jersey I.

most important being the **Tweed, Forth, Tay, Dee, Spey,** and **Ness.** The largest on the western slope are the **Clyde** and the **Ayr,** the former being one of the most famous commercial rivers in the world on account of its great trade and the extensive shipbuilding yards along its banks.

4. **Lakes.**—Scotland is noted for the beauty of its lakes, most of which lie amid wild mountain scenery. **Loch Lomond, Loch Awe,** and **Loch Ness** are the largest. The smaller lakes include **Loch Tay, Loch Katrine,** and **Loch Leven.** The last-named is situated in the Lowlands. and is famous for its island castle in which Mary Queen of Scots was imprisoned before her escape to England.

Ireland.

1. In Ireland, the highlands of the north are separated from those in the south by a large central lowland running from sea to sea, the height of which nowhere exceeds 300 feet above sea-level. As the coastal lands are for the most part higher than this **Great Central Plain,** which occupies about four-fifths of the total area of the country, much of the inland country is boggy or swampy; the largest morass, known as the **Bog of Allen,** occupying the very centre of Ireland.

2. Four clearly-marked **mountain systems** may be distinguished:—

(1) The **Northern System,** consisting of the mountains of Antrim and Donegal.

(2) The **Western System,** comprising the Connemara Mountains, and the Macgillicuddy Reeks.

(3) The **Southern System,** including the Galtee and the Knockmealdown Mountains.

(4) The **Eastern System,** consisting of the Wicklow and the Mourne Mountains.

3. **Rivers.**—With the exception of the **Shannon,** which flows through the Great Central Plain, the rivers of Ireland drain the coastal slopes, and are therefore short and of little commercial importance. The most important of these are the **Barrow,** the **Boyne,** and the **Foyle.**

(1) The **Shannon** (224 miles) the longest river in the British Isles, flows through Loughs Allen, Ree, and Derg to Limerick, where it opens out into a noble estuary. It is the only river of Ireland that is navigable for any considerable distance. It is noteworthy for its salmon-fishing.

(2) Reaching the east coast are the Lagan, Boyne, Liffey, and Slaney; while the Barrow, Suir, Blackwater and Lee reach the south coast.

4. **Lakes.**—Ireland abounds in lakes. The largest is **Lough Neagh,** with an area of 153 square miles (larger than Lake Wakatipu, but smaller than Lake Taupo). The most beautiful are the **Lakes of Killarney,** in County Kerry, situated amongst the loveliest scenery in Ireland. Loughs Allen, Ree, Derg, Mask, Conn, and Corrib, are other well-known lakes.

3. Climate.

1. The distance of the British Isles from the Equator; their insular position near a great continent on the one side and bordered by a vast ocean on the other; and the characteristics of their highlands and lowlands, should furnish us with indications as to the general nature of their climate, and therefore as to their adaptability for agriculture and pastoral pursuits.

2. The Lizard, one of the most southerly points of Great Britain, is situated in 50° north latitude; while the latitude of Kirkwall, in the Orkney Islands, in the north, is 59°. Great Britain, therefore stretches through about 9 degrees of latitude,

while its mean distance from the Equator is about 54½ degrees.

The mean distance of New Zealand from the Equator is about 41 degrees. According to latitude, therefore, the climate of Great Britain should be a little colder on the whole than that of New Zealand. Both are situated near the centre of a Temperate Zone. The South of England, being nearer the equator, is warmer than the north of Scotland.

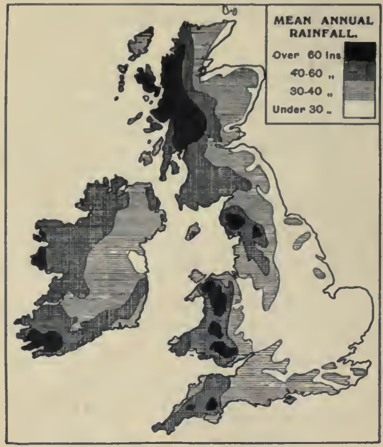
3. Observation of the thermometer at different times of the year shows that the coldest parts of the lowlands of Britain are found in the east, where the mean annual temperature of the air is under 38° Fahrenheit, in the south as well as in the north. On the western shores the mean annual temperature, both in the north and south, is over 42°.

How this difference in temperature in places not so very far apart may be accounted for, the following considerations will serve to show: —

(1) We must remember that the broad and deep Atlantic washes the western shores of the British Isles, while the Continent of Europe is very near its eastern and southern shores, being separated from them merely by narrow and shallow seas.

(2) We have already seen that water takes longer to heat and longer to cool than land does. The air over the sea will therefore be cooler in summer, and warmer in winter, than the layers of atmosphere over the land. The air is heated by contact with the sea or land to a greater degree than by the sun's rays passing through it. Consequently the prevailing winds which blow across the Atlantic to the western shores of Britain are cooler in summer, and warmer in winter, than the less frequent winds which blow from the Continent of Europe across the narrow seas bordering the eastern and southern shores.

(3) The waters of the shallow North Sea are colder in winter and warmer in summer, than the surface waters of the Atlantic; but as the winds blow from the Atlantic to Britain on two days out of every three, the result is that the temperature of the western shores is on the average higher



Rainfall Map of British Isles.

than is that of the eastern portion of the country. That is to say, the climate of the former is warmer than that of the latter, whether in the north or the south.

(4) We must also remember that, on the whole, the highlands of Britain lie nearer to the western than to the eastern shores. As these act as condensers to the moisture-laden westerly winds, they tend to make the rainfall heavier in the west than in the east, and far heavier among the mountains of western Scotland than on the lowlands of the south. Ireland, although of comparatively low elevation, partially intercepts the westerly winds, and should have a heavier rainfall than places of a corresponding elevation in Southern Britain.

(5) Actual observation and measurement of the rainfall in different parts of the country show that the conclusions we have arrived at are on the whole correct ones, as may be seen from the map on this page, which shows the average annual rainfall over different parts of the British Isles.

(6.) In New Zealand the average annual rainfall is about 45 inches, and the mean annual temperature about 54° F.

4. Influence of the Climate of Great Britain on its Agricultural and Pastoral Industries.

1. The agricultural and pastoral products of a country inhabited by industrious people depend principally on its climate and its soil. The nature of the soil itself is to some extent dependent on the climate; as warmth, moisture and frost help to crumble and sweeten the surface of the ground.

2. Farmers learn from experience where certain animals and crops may be raised most profitably. For instance, plenty of moisture in a warm or temperate country, where the soil is good, makes the grass grow green and luscious, and therefore capable of supporting herds of cattle. Such a country is naturally fitted for **dairying** purposes, and for the rearing of **cattle** for the meat-market.

(1) **Sheep** do not thrive so well where the climate is too wet, as they are liable to foot-rot and other diseases; while the cold and wet check the growth of the wool. They can, however, be more profitably reared in drier country, where the soil is perhaps not so good, and the pasture scantier, as on uplands and highlands. Accordingly we find that sheep do not thrive so well in Ireland as on the drier eastern slopes of the British highlands. Ireland is a moist country, with good pasture lands, and is therefore better suited on the whole for cattle than for sheep. In England, too, most cattle are reared on the moist western lowlands.

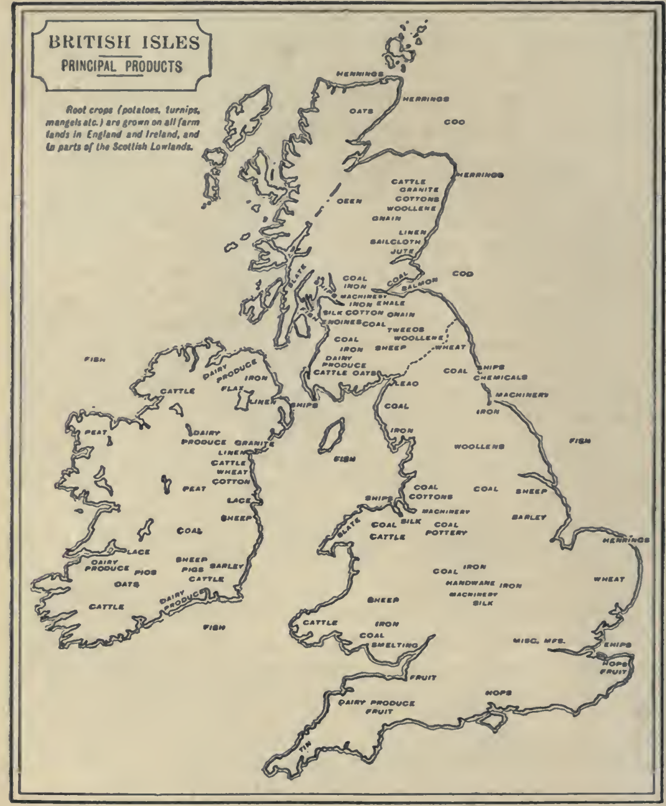
(2) **Wheat** crops require, on the whole, a slightly warmer temperature, a drier climate and better soil than **oats**, if they are to be profitably grown. Wheat-crops in the British Isles are therefore almost exclusively confined to England, and more particularly to the district between the Thames and the Wash. **Oats**, on the other hand, are the chief cereal of Scotland, a colder and less fertile country.

(3) In suitable localities other crops are grown. **Barley** is grown almost everywhere. **Potatoes** are largely produced in Ireland; **hops**, in the east of Southern England; **flax**, from which linen is manufactured, in the north of Ireland; and turnips, mangolds, and other similar root-crops, wherever they are required for cattle-feeding purposes.

5. Distribution of Population.

1. The population of the British Isles is upwards of 48,000,000. Of these nearly 39,000,000 live in England and Wales; nearly 5,000,000 live in Scotland, and about 4,200,000 in Ireland.

(1) The most densely populated parts of the country are the industrial districts of England and Wales, and portions of the Lowlands of Scotland. England itself is one of the most densely populated countries of Europe, averaging about 660 people to the square mile.



Products of British Isles.

(2) More than three-fourths of the people of South Britain live in the towns. London alone contains about one-sixth of the total population of the United Kingdom. The two most thickly populated districts are those of and

around Liverpool and Manchester, where the bulk of the people are employed in the manufacture of cotton goods. Within a radius of 35 miles of Manchester there is a denser population than in any other equal area in the world, outside of India or China.

2. In Ireland, the densest population is found in the industrial region of the north-east, round about Belfast, where ship-building and linen manufactures are carried on, and around Dublin. The inland towns are principally small market towns; Ireland being for the most part a stock-raising country, which is never capable of supporting a very dense population.

3. In Scotland, the bulk of the population is settled in the manufacturing districts of the Central Lowlands, and on the eastern coastal plain. None of the important towns of the country are more than 60 miles distant from one another. The greater part of Scotland, however, is very sparsely populated.

6. People and Language.

1. The great majority of the people of the British Isles belong to the **Teutonic** or Anglo-Saxon race, and speak English. Their ancestors came originally from parts of Holland, Germany, Denmark, and Norway, settling first along the eastern and southern shores of Britain, and driving westward and northward the **Celtic** tribes which then peopled the country.

2. The descendants of the latter are still found as a more or less distinct people in the western part of Ireland, in northern and western Scotland, and in Wales. In these districts the Celtic language is still spoken by a majority of the people, although most of them understand English. The English language

is spoken almost exclusively in the rest of the country.

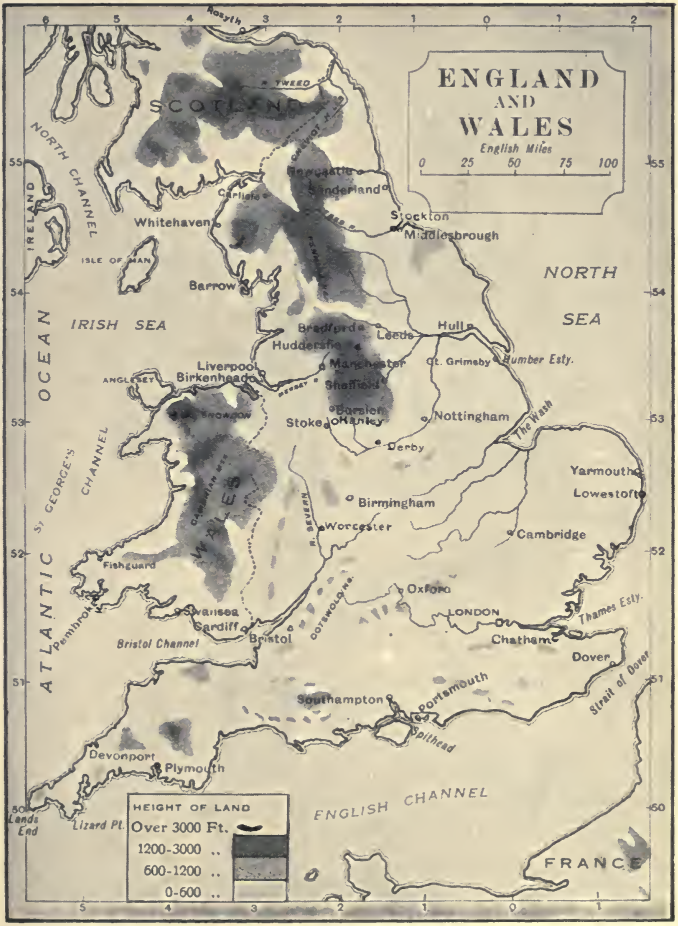
7. Table of British Coalfields.

(Their Characteristic Industries and Chief Manufacturing Centres).

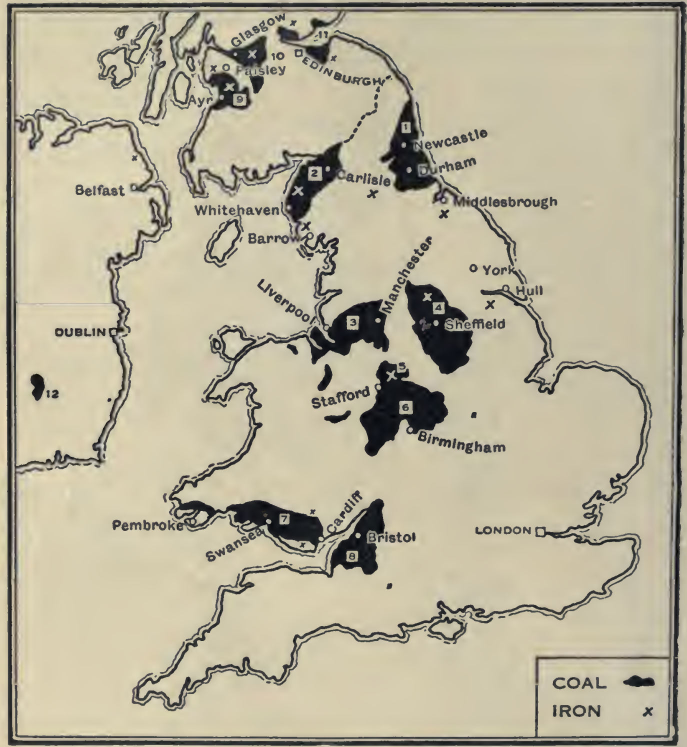
DISTRICT.	INDUSTRIES.	MANUFACTURING CENTRES.
ENGLAND.		
1. Newcastle ...	Machinery, guns, ship-building, glass, pottery, paper	Newcastle, Sunderland, Durham, Middlesbrough.
2. Cumberland	Iron, ship-building, exports coal to Belfast and other Irish industrial towns	Whitehaven, Carlisle.
3. South Lancashire	Cottons	Liverpool, Manchester, &c.
4. South Yorkshire	Woollens, iron goods, cutlery, armour plate	Leeds, Halifax, Huddersfield, &c. Sheffield.
5. North Staffordshire	Pottery	"The Potteries" (Stoke, Burslem, &c.
6. South Staffordshire	Hardware, cutlery, &c. ...	The Black Country: Wolverhampton, Birmingham, Walsall, &c.
7. South Wales	Iron and copper smelting ...	Swansea, Cardiff &c.
8. Bristol ...	Iron and glassware, sugar refining	Bristol.
SCOTLAND.		
9. Ayrshire ...	Woollens, carpets, machinery	Ayr, Kilmarnock.
10. Clyde Basin	Cottons, thread, iron, ship-building	Glasgow, Paisley, Port Glasgow, Greenock, Dumbarton.
	Iron goods	Airdrie, Coatbridge, Carron, Falkirk.
11. Firth of Forth	Ship-building, glass, iron	Alloa, Leith.
IRELAND.		
12. N. Kilkenny	—	—

8. Manufacturing and Other Industries.

1. Before the beginning of the last century the working people of Great Britain were principally engaged in agricultural and pastoral pursuits; a


ENGLAND AND WALES
English Miles
0 25 50 75 100
SCOTLAND
Rosyth
R. TWEED
CHEVIOT HILLS
NORTH CHANNEL
IRELAND
Carlisle
Newcastle
Sunderland
Stockton
Middlesbrough
Whitehaven
ISLE OF MAN
Barrow
PENNINE
NORTH SEA
IRISH SEA
OCEAN
Bradford
Leeds
Hull
Huddersfield
Manchester
Gt. Grimsby
Humber Esty.
Liverpool
Birkenhead
ANGLESEY
MERSEY
Sheffield
SNOWDON
Burslem
Hanley
Stoke
Nottingham
The Wash
Derby
ST GEORGE'S CHANNEL
WALES
CAMBRIAN MTS
Birmingham
Yarmouth
Lowestoft
R. SEVERN
Worcester
Cambridge
Fishguard
Oxford
ATLANTIC
Pembroke
Swansea
COTSWOLDS
LONDON
Thames Esty.
Cardiff
Bristol
Chatham
Bristol Channel
Dover
Strait of Dover
Southampton
Portsmouth
Spithead
Devonport
Plymouth
ENGLISH CHANNEL
Lands End
Lizard Pt.
FRANCE
HEIGHT OF LAND
Over 3000 Ft.
1200-3000 ..
600-1200 ..
0-600 ..

very much smaller number being occupied in the coastal fisheries, or in commerce and mining pursuits. The invention of the steam-engine, however, and the consequent use of efficient machinery; the increased development of the coal-fields, and the astonishing growth in wealth and importance of the over-sea dominions, have caused the larger part of



British coal and iron fields—one of the chief sources of Britain's industrial wealth*.

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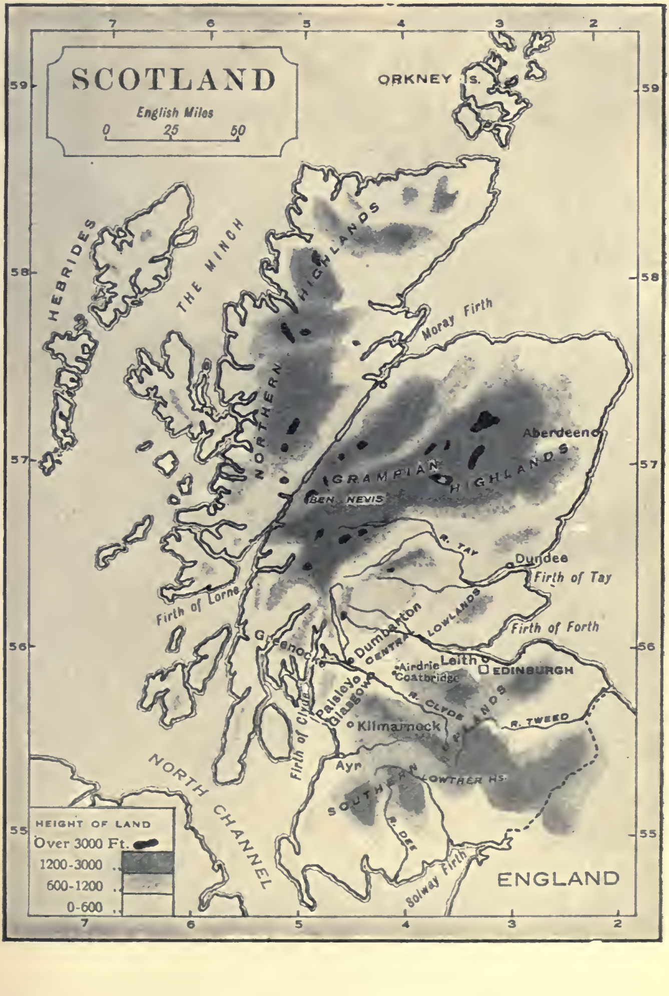
*As useful exercises prepare similar maps locating towns engaged in (*a*) textile industries, (*b*) metal manufactures, (*c*) pottery manufactures, etc.


SCOTLAND
English Miles
0 25 50
ORKNEY IS.
HEBRIDES
THE MINCH
NORTHERN HIGHLANDS
Moray Firth
GRAMPIAN HIGHLANDS
BEN NEVIS
Aberdeen
R. TAY
Dundee
Firth of Tay
Firth of Lorne
Dumbarton
CENTRAL LOWLANDS
Firth of Forth
Greenock
Airdrie
Coatbridge
Leith
EDINBURGH
Paisley
Glasgow
Firth of Clyde
R. CLYDE
Kilmarnock
UPLANDS
R. TWEED
Ayr
LOWTHER HS.
SOUTHERN
R. DEE
Solway Firth
ENGLAND
NORTH CHANNEL
HEIGHT OF LAND
Over 3000 Ft.
1200-3000
600-1200
0-600
7
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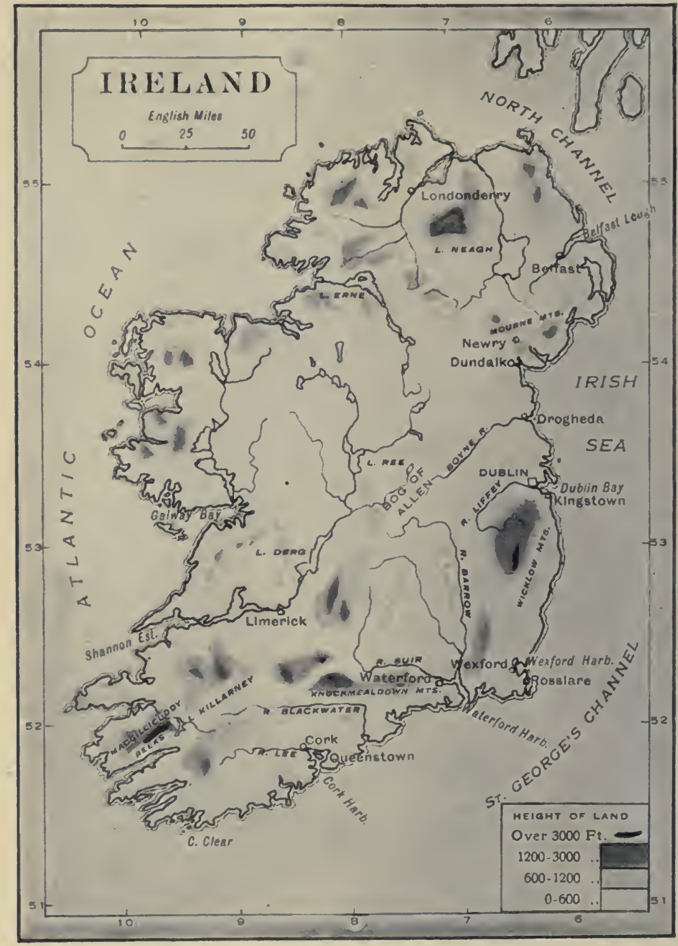


The new boundary of Ulster includes the counties of Antrim, Armagh, Down, Fermanagh, Londonderry and Tyrone, and the two Parliamentary boroughs of Belfast and Derry. The remainder of Ireland constitutes the new Irish Free State.

the British population to become engaged in **manufacturing, mining,** and **commercial** pursuits.

2. The largest and most valuable of the manufactures of Great Britain is that of **cottons,** the importance of which may be judged from the fact that cotton goods to the value of from £150,000,000 to £200,000,000 are annually exported from the country.

Underwood and Underwood, photo

George Square, Glasgow.

The principal centres of cotton manufactures are **Manchester** and the other "Cotton-towns" of the South Lancashire coal-field, in England; and **Glasgow, Paisley,** and **Aberdeen** in Scotland.

3. The manufactures of **metal** goods, **machinery** and **steam-engines** come next in value, the annual export of these being nearly £140,000,000.

Iron and steel goods are largely manufactured in the districts around **Birmingham** and **Sheffield** in England, and around **Glasgow** in Scotland.

4. The **woollen** manufactures, carried on principally on the Yorkshire and Lancashire coal-fields, at **Leeds, Bradford, Huddersfield,** and other towns in England, and in the basin of the Tweed in Scotland, come next in importance with an annual export of goods amounting to from £50,000,000 to £90,000,000 in value. Much of the raw wool used for manufacturing purposes is imported from Australia, New Zealand, South Africa, and India.

5. Linens are manufactured in and around **Belfast,** in the north-east of Ireland, where the flax-plant (*Linum*) is cultivated; and at Dundee, in Scotland, where the raw material is obtained principally from Russia, not far away, the largest flax-producing country of Europe. At Dundee, too, cordage and sail-cloth are largely manufactured.

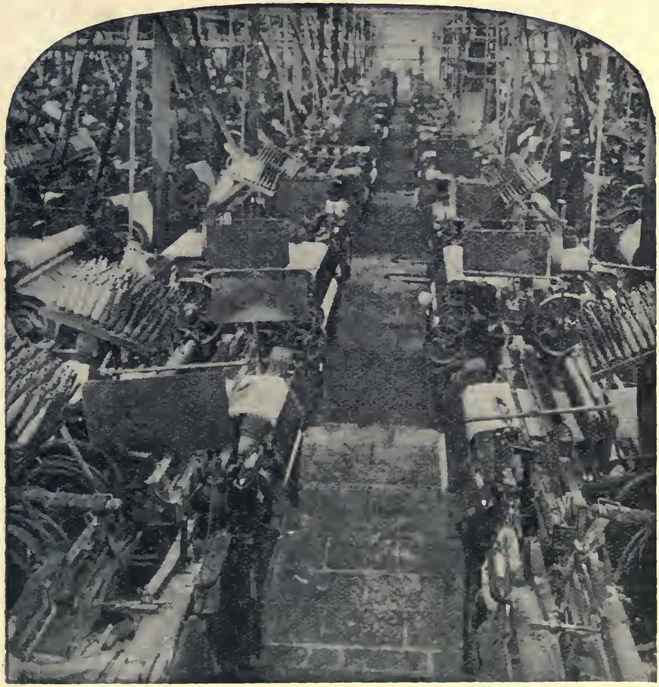
6. **Coal, coke,** etc., are exported to the value of from £50,000,000 to £90,000,000.

7. **Earthenware** and **porcelain** are manufactured in the **Potteries** district of England, at Burslem, Stoke, Hanley, and at Worcester and Derby.

8. **Ship-building,** one of the most important industries of Great Britain, is carried on at the mouths of the Tyne (Newcastle), Wear (Sunderland), and Tees (Stockton); at Hull, and **Liverpool**; on the **Thames**; at **Glasgow,** Greenock, and other towns on the Clyde; and at **Belfast.**

Warships are constructed principally in the Government Dockyards of Chatham, Devonport, Portsmouth, Pembroke, and Rosyth, as well as in private dockyards in other places.

9. **Fisheries.**—The seas and rivers of Great Britain abound in fish, which furnish an important part of the food supply of the country. The fish caught are herring, mackerel, cod, haddocks, pilchards, plaice, soles, turbot, halibut, shell-fish (lobsters, crabs, oysters, etc.), and salmon (chiefly in the Irish and Scottish rivers). The principal ports at which the



Underwood and Underwood. photo

Weaving Room in a Linen Mill, Belfast.

fish are landed are London, Grimsby, Hull, Lowestoft, Yarmouth, and the eastern ports of Scotland.

9. Sources of Food Supply.

1. The fact that Great Britain has such a large and over-crowding population to support, and that the bulk of its people is engaged in manufacturing and commercial instead of agricultural and pastoral occupations, renders it incapable of raising sufficient wheat, oats, sheep and cattle to supply its own people with necessary food. A large proportion of the food-stuffs consumed has therefore to be imported from abroad.

2. It is all-important, therefore, that Britain should have plenty of ships of her own to carry these necessary food supplies, and that she should also possess a sufficient number of efficient warships to protect her transport trade in time of war.

3. It is thought that if England were at war with a strong naval power, and serious disaster happened to overtake her navy, the enemy would be able to blockade her ports so closely and effectually that her food supplies from abroad would be completely cut off. If this were the case for even a few weeks, the people of Great Britain would have either to starve or make ignominious terms with the enemy.

The importance of maintaining a strong navy to protect her shipping in war-time and thus keep her people from possible starvation, cannot therefore be over-estimated. In the Great War Britain's oversea trade was not seriously interfered with, while that of Germany practically ceased to exist.

4. The following table* shows the chief articles of food obtained principally from abroad, and the countries from which they are received:—

ARTICLES OF FOOD.	OBTAINED PRINCIPALLY FROM
Grain and flour (principally wheat) ..	Canada, United States, Argentina, Australia, India.
Meat (including live cattle) ..	United States, Australia, New Zealand, Canada, Argentina.
Sugar ..	United States, Canada, Java, British Guiana, British West Indies, Mauritius, Peru.
Butter ..	Denmark, Australia, New Zealand, Argentina.
Tea ..	India, Ceylon, Java, China.
Wine ..	Portugal, France, Australia, South Africa, Spain.
Eggs ..	France, Belgium.
Cheese ..	Canada, Australia, New Zealand.
Fruits ..	Australia, Canada, West Indies, Spain, Portugal, Italy, Greece, Turkey, United States, New Zealand.

10. Other Imports.

1. Great Britain also obtains from other countries the bulk of the raw material used in her extensive manufacturing industries. For instance, she is the greatest manufacturer in the world of cotton and woollen goods, and the whole of the raw cotton and most of the wool used for these purposes she imports from abroad.

Other raw materials, such as timber, flax, raw silk, oils, etc., are also imported.

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*A useful exercise for the pupil would be to insert in a blank map of the world the names of the different articles imported, according to the country of origin.

2. Besides food-stuffs, the other principal articles imported are:—

ARTICLES.	OBTAINED FROM
Raw Cotton ..	United States, Egypt, India, Peru.
Wool ..	Australia, New Zealand, South Africa, Argentina, India.
Wood and Timber ..	United States, Canada, Russia, Scandinavia, Burma.
Raw Silk ..	China, Japan, Italy.
Manufactured Silk ..	Switzerland, Japan.
Woollens ..	France, Holland.
Leather and Hides ..	United States, India, France, Australia, New Zealand, South Africa, South America.
Coffee ..	Brazil, Costa Rica, India, Ceylon.
Tobacco ..	United States, India, Cuba, Greece.
Chemicals and Dye-stuffs ..	West Africa, Brazil, East Africa.
Motor Spirit ..	United States, Persia, Dutch Borneo.
Fuel Oil (petroleum) ..	Mexico, United States.
Rubber ..	Federated Malay States, Ceylon, East Indies, Brazil.
Gold ..	Australia, New Zealand, Canada, South Africa.
Silver ..	New South Wales, Queensland, Mexico.
Copper ..	Australia, Spain, United States.
Tin ..	Straits Settlements, Australia.

3. About one-sixth of the value of the total imports consists of such raw material as cotton, wool, flax, hemp, silk, jute, etc., used in the textile industries. About one-fourth of the imports in value are obtained from the United States, the chief articles being raw cotton, grain, bacon and hams, meat, fruit, and tobacco. The oversea dominions and India supply another fourth.

11. Exports.

Britain's vast manufacturing industries, upon which the welfare of her people so largely depends, furnish the bulk of her exports. The chief articles of export, and the countries to which they are sent are:—

ARTICLES OF EXPORT.	WHERE SENT.
Cotton goods and yarn..	India, China, Egypt, Australia, Argentina, Turkey
Iron and steel goods, hardware, cutlery ..	To all parts of the world.
Woollen goods ..	Japan, United States, France, Netherlands, Australia, New Zealand
Coal ..	France, Italy, Netherlands, Spain, Sweden.
New ships ..	All parts of the world.
Machinery ..	India, France, Japan, Australia, New Zealand.
Chemicals ..	United States and British Possessions.
Wearing apparel, linen goods, jute manufactures, earthenware and porcelains ..	The over-sea Dominions, and many other countries.

The Oversea Dominions take more than a fourth of the total exports of Great Britain, India alone taking over £40,000,000 annually in value. Her other customers are United States, Germany, France, Netherlands, Argentina, Belgium, Italy, Japan, etc.

12. Commerce.

Great Britain is the greatest trading country in the world; a fact that is to a great extent due to,

(1) Its splendid commercial position, aided by the facilities afforded by its numerous good natural harbours and navigable rivers.

(2) Its favourable climate.

(3) The richness and extent of its coal and iron fields.

(4) The extent and resources of its world-wide dominions.

(5) The character and enterprise of its people.

13. Internal Communication.

1. Just as Great Britain has ships sailing on every sea to and from every port in the world, so she has railways connecting every town of importance with the great seaports, and therefore with all the world. Her many navigable rivers, too, and her numerous canals, help to make the carriage of goods through the country additionally easy and convenient.

The railway lines of Great Britain measure some 25,000 miles in length, a distance equal to the circumference of the earth at the equator, or more than double the combined lengths of the Nile, the Amazon, and the Mississippi.

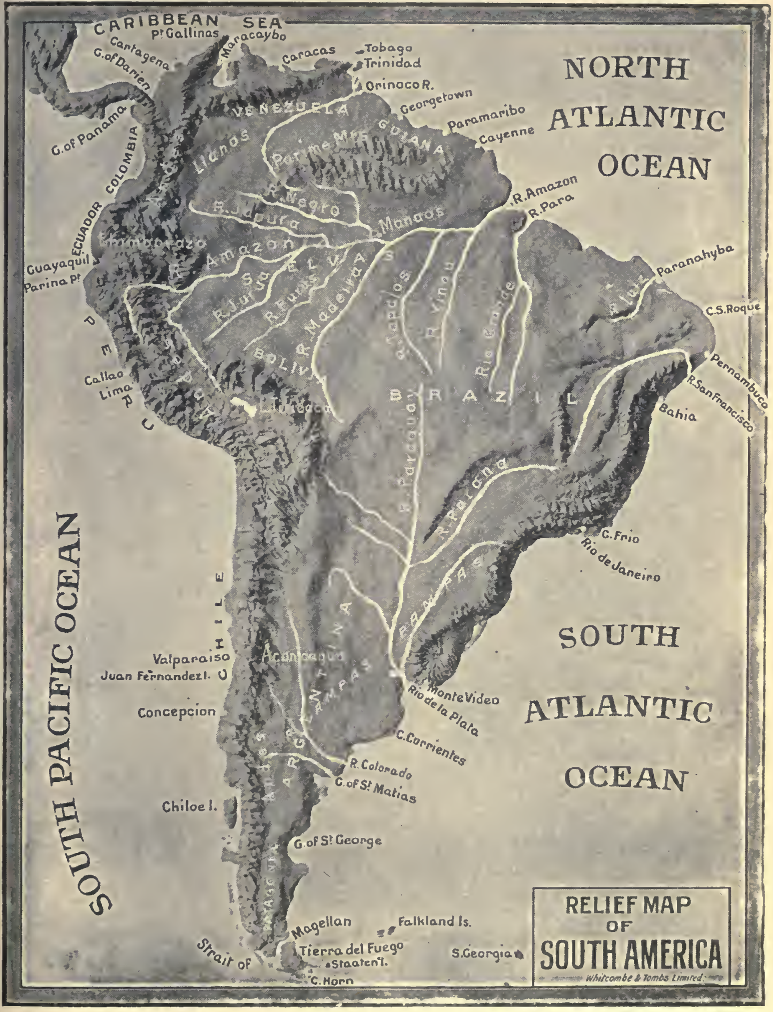
14. Defence.

1. Great Britain's **First Line of Defence** is her navy, and this is by far the greatest and most powerful navy in the world. The reasons for keeping it so have already been indicated on page 156. The naval policy of Great Britain is therefore to maintain a navy which shall at any time be at least nearly equal in strength to the navies of any two other Powers in combination.

Besides her navy, Britain has a small but efficent regular army, for service abroad if necessary, a small territorial army for home defence, and a still smaller army reserve.

2. OTHER BRITISH TERRITORY IN EUROPE.

In addition to the British Isles, the British territory in Europe comprises the **Channel Islands**, **Gibraltar**, and the **Maltese Islands** (Malta and Gozo).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Trinidad
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Georgetown
Paramaribo
Cayenne
NORTH ATLANTIC OCEAN
VENEZUELA
GUIANA
Parime Mts
Llanos
COLOMBIA
ECUADOR
Andes
R. Negro
R. Japura
Manaos
R. Amazon
R. Para
Chimborazo
Amazon
Guayaquil
Parina Pt
Selvas
R. Jurua
R. Purus
R. Madeira
R. Tapajos
R. Xingu
Rio Grande
Paranahyba
C. S. Roque
Pernambuco
R. San Francisco
Bahia
PERU
Callao
Lima
BOLIVIA
Titicaca
BRAZIL
R. Paraguay
R. Parana
C. Frio
Rio de Janeiro
PAMPAS
SOUTH ATLANTIC OCEAN
SOUTH PACIFIC OCEAN
CHILE
Valparaiso
Juan Fernandez I.
Aconcagua
ARGENTINA
PAMPAS
Monte Video
Rio de la Plata
Concepcion
C. Corrientes
R. Colorado
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Chiloe I.
Andes
G. of St George
PATAGONIA
Magellan
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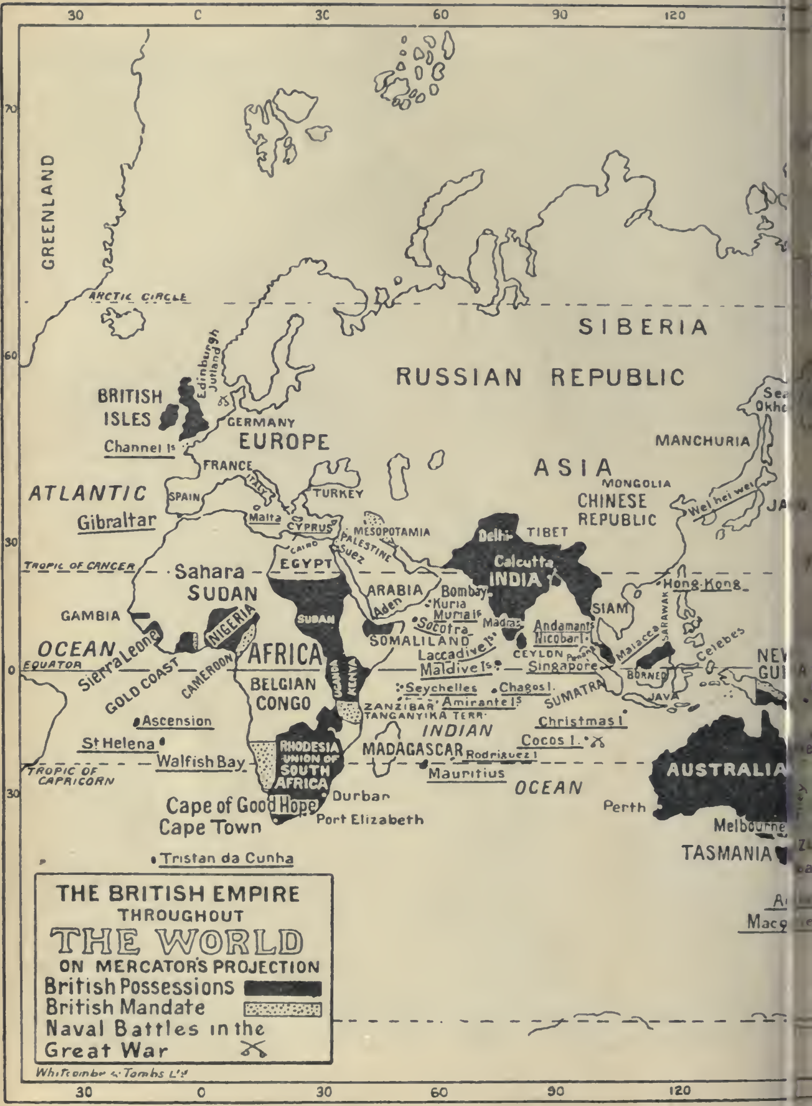
Falkland Is.
Tierra del Fuego
Staaten I.
C. Horn
S. Georgia
RELIEF MAP OF SOUTH AMERICA
Whitcombe & Tombs Limited.


THE BRITISH EMPIRE
THROUGHOUT
THE WORLD
ON MERCATOR'S PROJECTION
British Possessions
British Mandate
Naval Battles in the Great War
Whitcombe & Tombs Ltd
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GREENLAND
ARCTIC CIRCLE
SIBERIA
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Jutland
GERMANY
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Channel Is
FRANCE
SPAIN
ITALY
TURKEY
ATLANTIC
Gibraltar
Malta
CYPRUS
MESOPOTAMIA
PALESTINE
Suez
CAIRO
EGYPT
TROPIC OF CANCER
Sahara
SUDAN
GAMBIA
NIGERIA
SUDAN
ARABIA
Aden
OCEAN
Sierra Leone
GOLD COAST
CAMEROON
AFRICA
EQUATOR
BELGIAN CONGO
UGANDA
KENYA
ZANZIBAR
TANGANYIKA TERR.
Ascension
St Helena
Walfish Bay
RHODESIA
UNION OF SOUTH AFRICA
TROPIC OF CAPRICORN
Durban
Cape of Good Hope
Cape Town
Port Elizabeth
Tristan da Cunha
MADAGASCAR
Rodriguez I.
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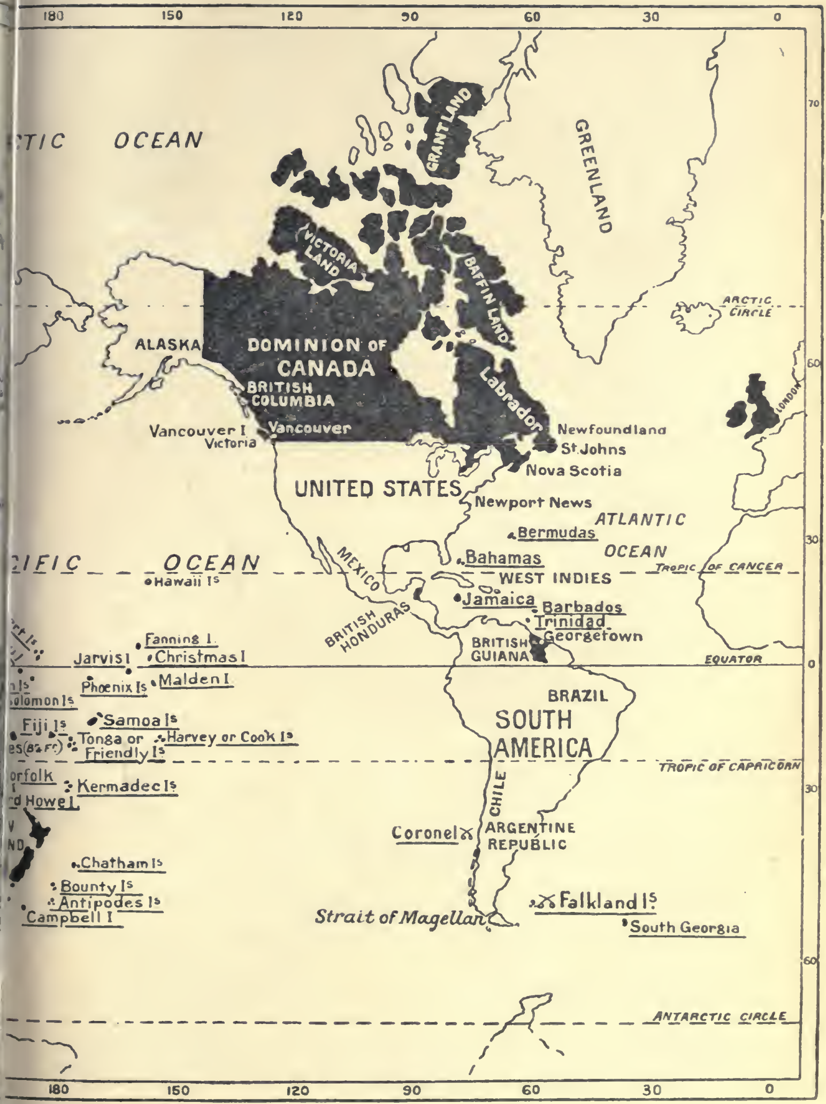
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TIC OCEAN
GRANT LAND
GREENLAND
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ARCTIC CIRCLE
ALASKA
DOMINION OF CANADA
BRITISH COLUMBIA
Labrador
LONDON
Vancouver I
Victoria
Vancouver
Newfoundland
St. Johns
Nova Scotia
UNITED STATES
Newport News
ATLANTIC OCEAN
Bermudas
Bahamas
CIFIC OCEAN
Hawaii Is
MEXICO
WEST INDIES
TROPIC OF CANCER
Jamaica
Barbados
Trinidad
Georgetown
BRITISH HONDURAS
BRITISH GUIANA
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Fanning I.
Jarvis I
Christmas I
Phoenix Is
Malden I
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SOUTH AMERICA
Fiji Is
Samoa Is
Tonga or Friendly Is
Harvey or Cook Is
es (Br. & Fr.)
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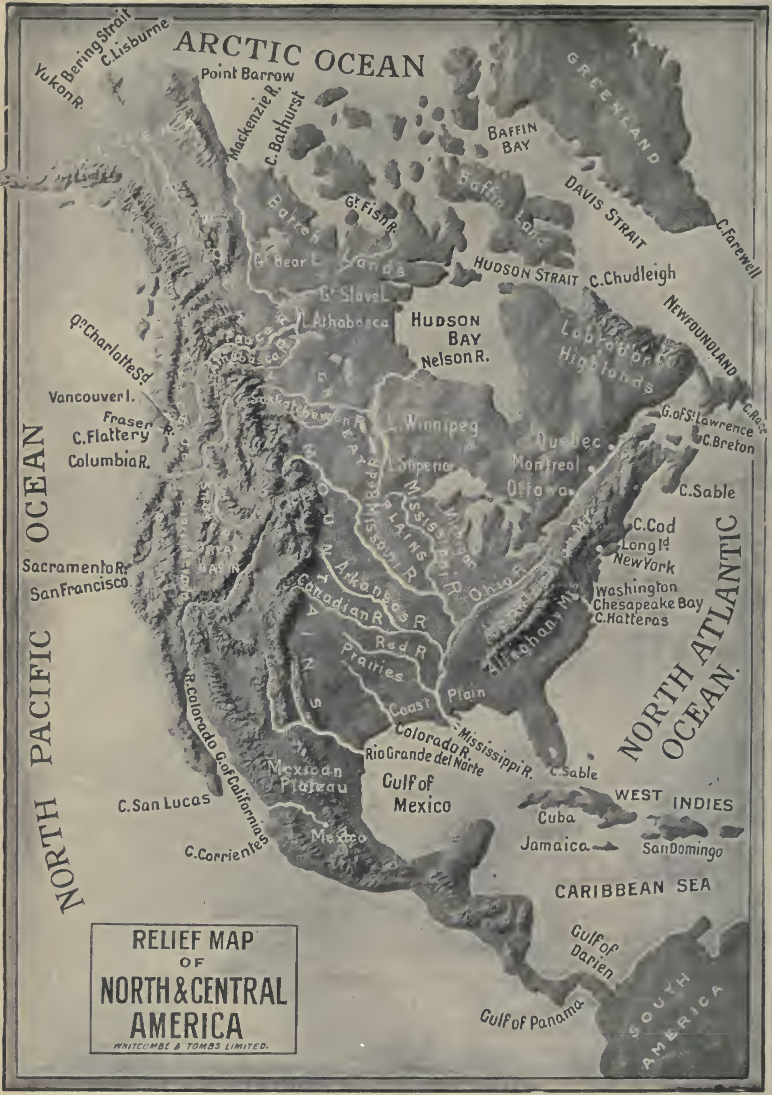
rd Howe I
TROPIC OF CAPRICORN
CHILE
Coronel
ARGENTINE REPUBLIC
ND
Chatham Is
Bounty Is
Antipodes Is
Campbell I
Falkland Is
Strait of Magellan
South Georgia
ANTARCTIC CIRCLE



RELIEF MAP
OF
NORTH & CENTRAL
AMERICA

WHITCOMBE & TOMBS LIMITED.

1. The **Channel Islands*** are a group of small islands in the English Channel near the French coast. At the time of the Norman Conquest they formed part of the Duchy of Normandy and have remained English territory ever since. The people are a mixture of English and French, but most of them speak the French language in their daily intercourse with one another. The population is about 90,000. The main industry of the islands (the largest of which are Jersey, Guernsey, Alderney, and Sark) is market gardening. Potatoes, tomatoes, grapes, fresh flowers, butter and eggs are largely produced for the English market. The fisheries, too, are important, including lobster and cod. The chief towns are **St. Helier** in Jersey, and **St. Pierre**, in Guernsey.

2. **Gibraltar** is a strong British fortress in the South of Spain guarding the Straits of Gibraltar, the entrance to the Mediterranean. It was taken from the Spanish in 1704, and is a very strongly fortified coaling and military station. The area of Gibraltar is nearly 2 square miles, and its population is about 21,000, including a military and naval garrison of about three thousand men.

3. **Malta.**—The Maltese Islands, in the Mediterranean, about 60 miles from Sicily, have an area of about 122 square miles, and a population of about a quarter of a million, including a British garrison of 9,000 men. Malta is the chief coaling station of the British Mediterranean fleet. **Valetta,** with extensive dockyards, is the chief town.

The island is of great historic interest. It was the headquarters of the military order of the Knights of St. John, who helped to defend Europe against the Turks. It was occupied by the French, and then by the British under Nelson.

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*See map on page 140.

4. **Cyprus**, a long island in the Levant, as the eastern part of the Mediterranean is called, has been under British occupation since 1878, and was formally annexed in 1914. Its chief products are cotton, wine, wheat, barley, wool, silk, sponges, and raisins. Being close to the coast of Asia Minor, Cyprus is usually classed among our Asiatic possessions.

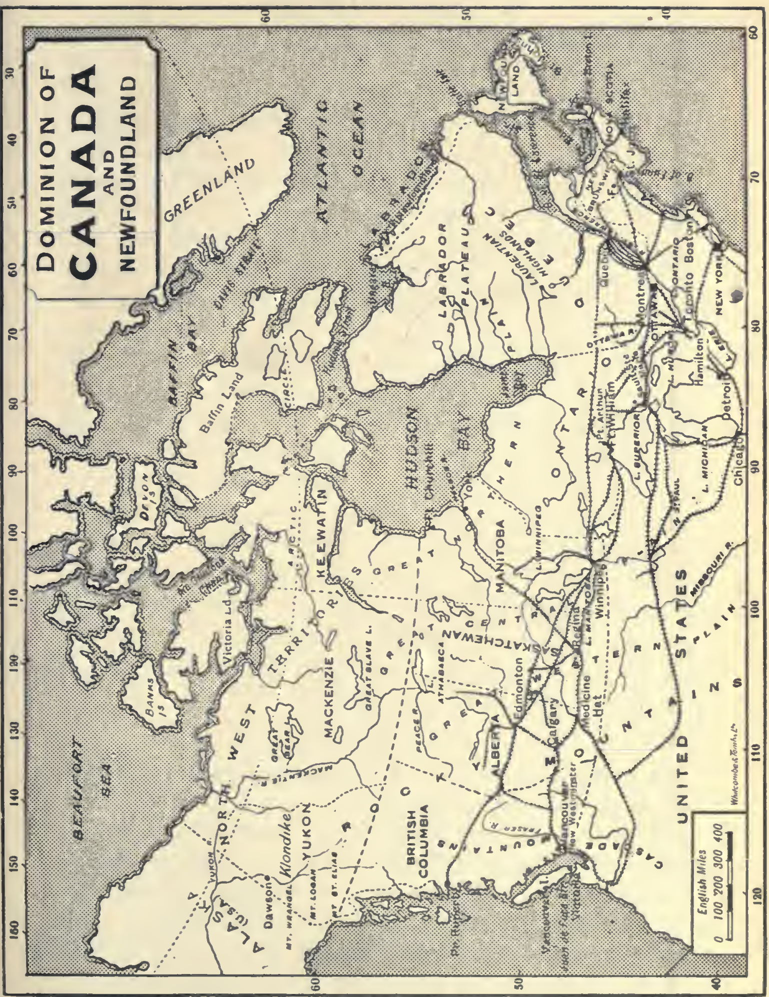
3. THE BRITISH DOMINIONS IN AMERICA.

1. THE DOMINION OF CANADA.

1. Area and Population.

The **Dominion of Canada** is the largest undivided portion of the British Empire. It occupies about one-third of the North American continent; has an **area** exceeding 3½ million square miles; and is therefore larger than Australia and New Zealand together, and almost as large as Europe. Its **population**, which is increasing yearly, numbers over 9½ million persons.

"Picture to yourselves a domain nearly as large as Europe, stretching from the Atlantic to the Pacific Ocean, with its southern extremity in the same latitude as the south of France, and its northern boundary along the shores of the Arctic Ocean. Possessing the finest forests in the world, widely-spread coal-fields, most extensive and productive fisheries, watered by the most remarkable and natural distribution of lakes and rivers, enriched with all varieties of minerals, and possessing enormous areas of fertile prairie-lands destined to become the future granary of England,—this vast country reaches, as the crow flies, from ocean to ocean, 4,000 miles, with an area south of the latitude of St. Petersburg of at least 2,000,000 of square miles, capable


DOMINION OF
CANADA
AND
NEWFOUNDLAND
GREENLAND
ATLANTIC OCEAN
BAFFIN BAY
Baffin Land
DEVON IS.
Victoria Ld.
BANKS IS.
BEAUFORT SEA
ALASKA (U.S.A.)
Dawson
Klondike
YUKON
MT. WRANGEL
MT. LOGAN
MT. ST. ELIAS
BRITISH COLUMBIA
NORTH WEST TERRITORIES
MACKENZIE
KEEWATIN
ARCTIC CIRCLE
GREAT BEAR L.
GREAT SLAVE L.
ATHABASCA L.
PEACE R.
MACKENZIE R.
HUDSON BAY
Churchill
York
LABRADOR
LABRADOR PLATEAU
LAURENTIAN HIGHLANDS
QUEBEC
ONTARIO
NORTHERN ONTARIO
MANITOBA
SASKATCHEWAN
ALBERTA
GREAT CENTRAL PLAIN
Edmonton
Calgary
Medicine Hat
Regina
Winnipeg
L. WINNIPEG
L. MANITOBA
Pt. Arthur
Ft. William
L. SUPERIOR
L. HURON
L. MICHIGAN
L. ERIE
L. ONTARIO
OTTAWA
Montreal
Quebec
Toronto
Hamilton
Detroit
Chicago
Boston
NEW YORK
NEW BRUNSWICK
NOVA SCOTIA
Halifax
St. John
Cape Breton I.
NEWFOUNDLAND
UNITED STATES
MISSOURI R.
ST. PAUL
FRASER R.
Vancouver
New Westminster
Victoria
Vancouver I.
Pr. Rupert
Juan de Fuca Str.
CASCADE MOUNTAINS
ROCKY MOUNTAINS
GREAT PLAIN
English Miles
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Whitcombe & Tombs, Ltd.

of cultivation, and of which fully one-half produces every crop that is grown in Great Britain.''

2. Commercial Position.

1. Stretching from the Atlantic to the Pacific, with a long coast line on either ocean, Canada can trade as readily with Asia, Australia, and New Zealand as with Southern America and Europe. South of the Dominion is the great trading country of the United States, with which her important towns have easy communication by rail, river, lake and sea. Her many large rivers, great lakes, and other navigable waterways, afford a vast natural inland communication which renders travelling and transit easy. The Canadian Pacific Railway, too, running right across the continent, connects the east and west coasts, and, from its terminus on either ocean, sailing ships and steamers trade with all parts of the world. The main line of this road, extending from Vancouver, B.C., to St. John, New Brunswick, is 3367 miles. Two other transcontinental railways now belong to the Canadian Government, and are known as the Canadian National Railways. They run from Halifax in Nova Scotia, to Vancouver and Prince Rupert in British Columbia, and also have connections with U.S.A. lines to Portland and Chicago.

3. Surface.

1. Canada is a land of vast grassy plains, fringed by highlands or mountainous country on the east and west. It has great mineral wealth, a fertile soil, and valuable fisheries. The western portion is mountainous, and includes the **Rocky Mountains**, the **Cascade Mountains**, and the **Coast Range**, their highest peaks attaining a height of over 13,000 feet. Across these in the south are several comparatively low passes through which the Canadian Pacific Railway runs.

2. The eastern portion of Canada is beautifully diversified with forest-clad hills and sheltered valleys; the **Eastern Highlands** forming a rugged plateau which occupies almost the whole of Labrador. From a height of nearly 4,000 feet, near the Atlantic coast, this plateau slopes gradually westward, forming the drowned valley or plain of **Hudson Bay.**

3. Between the Western Mountains and the Eastern Highlands stretches the **Great Central Plain,** dotted over with fertile prairie-land, beautiful lakes, and numerous rivers. The **North West Territory** includes the forest-clad district around Hudson Bay; the fur-producing country of the Mackenzie; and the rich gold-bearing country around the sources of the Yukon River.

4. The chief **river** of Canada is the **St. Lawrence,** 2,000 miles in length, draining the Great Lakes, and flowing into the Gulf of St. Lawrence. The Falls of Niagara* occur on this river between Lakes Erie and Ontario. Other large and important rivers are the **Mackenzie,** draining the eastern slopes of the Rocky Mountains, and reaching the Arctic Ocean after flowing through several lakes; the **Nelson,** flowing from Lake Winnipeg into Hudson Bay; the **Fraser,** draining the western slopes of the Rocky Mountains, and flowing through British Columbia into the Pacific; and the gold-bearing **Yukon,** which reaches Bering Sea through Alaska.

4. Climate.

1. The absence of long and high mountain ranges running in an easterly and westerly direction exposes the country to cold winds from the north

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*Harnessed to produce electricity for industrial and domestic purposes. At night the Falls themselves are illuminated by electricity generated by its own power.

The soft south-west winds from the Pacific, resembling our own "westerlies," shed their moisture in heavy rain or snow on the western slopes of the Coast Range, and blow as dry, warm winds down the eastern slopes of the "Rockies," causing the snow there to disappear as if by magic.* These "Chinook" winds, as they are called, blow across Southern Alberta and Saskatchewan. The icy ocean current from Polar regions that flows down the eastern shores of Canada lowers the temperature of the air over it, causing cold easterly winds to blow across Labrador and the eastern provinces.

2. For the reasons indicated, therefore, Western Canada has in general a somewhat higher temperature and greater rainfall than Eastern Canada. In the latter, however, the snow-fall is remarkably heavy; and the average temperature is much lower than in corresponding latitudes of Europe.

The country round Montreal, for instance, is covered with so thick a coating of snow during the long winter that outdoor work is almost suspended; but at Bordeaux in the south of France, in nearly the same latitude, the winter is short and mild, and snow is rarely seen. Labrador, too, is icebound for the greater part of the year; while in the British Isles, in the same latitudes, even the winters are comparatively mild.

3. The climate of the interior lowlands or prairie lands, including Alberta, Saskatchewan, and Manitoba, is continental, that is, it is characterised by extreme cold in winter and relatively high temperatures in summer. The range of temperature from mid-summer to mid-winter is from 65° to 70°. There

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*When water vapour is changed into liquid water latent heat is set free, and the temperature rises. The warm föhn winds from the Alps, called by the Swiss "snow-eaters," are due to the same cause. Our nor'-westers in New Zealand are similar winds, shedding their moisture on the western slopes of the Southern Alps, and passing over the Canterbury Plains as warm, dry winds.

is a moderate snowfall, and a rather scanty rainfall, which occurs chiefly in summer. The conditions described have helped to render this region famous for the production of wheat.

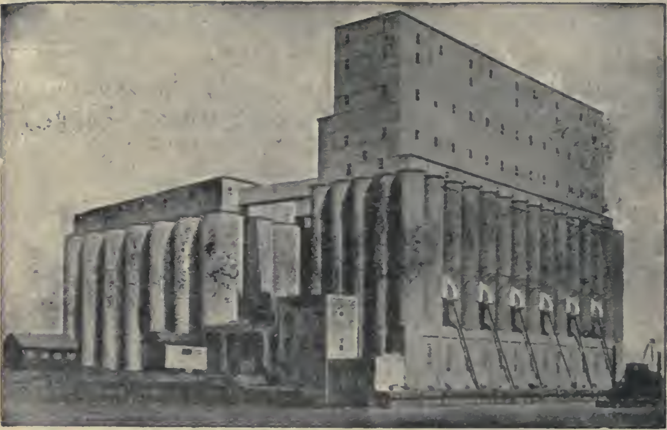
4. In Canada, though the winters are cold and long, they are dry, clear, and invigorating, and the cold is not so severely felt as in places where the climate is moister. The summers, on the other hand, are warm and bright, and, as the days are then very long, the greater period of sunshine quickly ripens the grain crops and makes the country extremely favourable for agricultural and gardening pursuits. In the south oranges and tomatoes ripen in the open air, and maize is a natural product.

5. Commerce and Industries.

1. The ocean-going, coastal, and inland shipping of Canada is of very much greater aggregate tonnage than that of any other of the Oversea Dominions. The bulk of the trade is carried on with the United States and Great Britain: the former supplies most of the imports, and the latter takes about one-third of the exports. A considerable trade is conducted with Australia and New Zealand through the western port of Vancouver, as well as through the eastern ports of Halifax and Montreal. The principal imports from Australasia are wool and skins, butter, fresh and dried fruits, and frozen meat. The principal goods exported in exchange are motors, other machinery, printing-paper, timber, boots, and salmon.

The most important general **exports** of Canada are wheat, flour, timber, paper, wood pulp, iron goods and machinery, vehicles, cheese, bacon, oats, rubber, and fish. Among the chief **imports** are machinery, hardware, coal, woollens, cottons and silks, sugar, and petroleum.

2. The most important industries carried on in Canada are those in connection with **agriculture** and **forestry** or lumbering, the principal productions being **wheat** and **timber**. The Provinces of **Saskatchewan**, **Manitoba**, **Alberta** and **Ontario** contain the chief wheat-growing areas.



Wheat Elevator, Canada—A huge building in which wheat is stored loose, and from which trucks or vessels are quickly loaded by means of pipes or spouts.

(1) Like Australia, Canada grows much more **wheat** than is needed to supply the requirements of her own people. The surplus, amounting to many millions of bushels, is exported to help to feed the people of Great Britain. Australian and New Zealand wheat ripens from December to February; while Canadian wheat ripens in September, so that these countries do not compete with each other in the sale of wheat in the European market.

(2) In Australia the wheat farmer often has to contend against drought; in Canada he dreads the early autumn frosts which sometimes spoil his crop before it is ripened. Australian and New Zealand wheat is packed in sacks* which have to be handled several times before the grain reaches the holds of the ships. In Canada, the wheat is carried

---

*Elevators are used also in Australia.

loose. It is carted or railed from the farms to the elevators, or lofty warehouses, where it is lifted by machinery to the upper floors, whence it can flow down a large pipe or shoot into the railway trucks, or into the holds of ships for carriage abroad.*

(3) Oats are also largely cultivated, chiefly in the Province of Ontario, and are exported in great quantities to Great Britain.

3. **Canada** has probably the largest supply in the world of **timber** useful for building and manufacturing purposes. At present, forestry is most extensively carried on in the eastern provinces, from which sawn timber is exported to Europe in large quantities. Much of the timber, too, (soft-woods, such as hemlock and spruce) is made into wood-pulp, from which paper is now principally made. **Ottawa** is the principal centre of this industry. Canadian timber is also exported to Australia and New Zealand.

4. The useful **minerals** of Canada are well distributed, and occur in large quantities. Rich **goldfields** are worked in the Yukon district, chiefly at **Dawson**, at the junction of the Klondike and Yukon Rivers, as well as in southern British Columbia, while the **Hollinger** mine in Ontario is the second largest gold producer in the world. Valuable coal mines are found in Nova Scotia on the Atlantic, and in Vancouver Island on the Pacific Coast. **Iron, silver, copper,** and **petroleum** are also found in abundance, particularly along the northern shores of Lake Superior.

5. The Canadian **fisheries** are amongst the most valuable in the world, affording large supplies of cod, mackerel, lobsters, herrings, and salmon. The Fraser and other western rivers supply annually millions of salmon. These are cured or preserved in the numerous canning factories along the western shores, and are exported in large quantities to all

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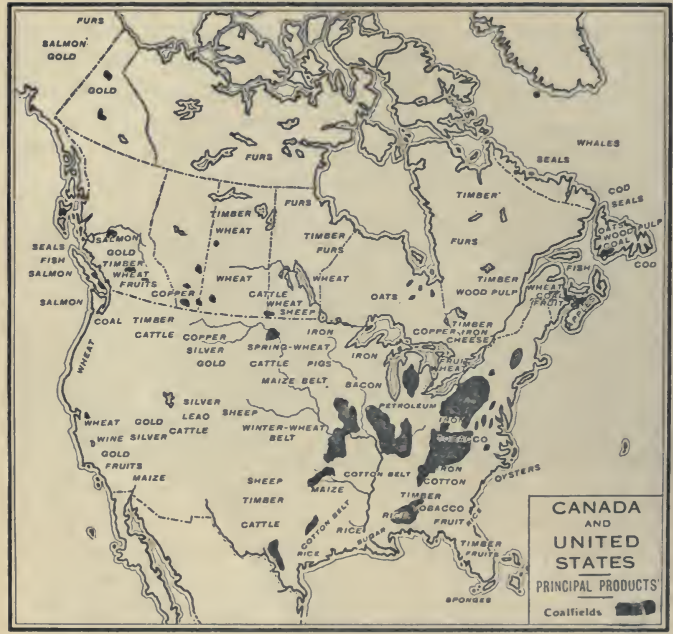
*The "whaleback" steamers, once so common on the Great Lakes for the transport of wheat, have now been superseded by a new type of steel vessels.

parts of the world. The cod fisheries of the eastern coasts, including those of Newfoundland, supply dried fish to all the world.

6. The **fur** trade of Canada is extensive. In the frozen regions of the north the bear, the beaver, the fox, the sable, the seal, and the ermine are protected from the extreme winter cold by their warm, soft coats of fur. The hunting and trapping of these animals, therefore, furnishes occupation for quite a large number of people.



7. The people of Canada, like those of Australia and New Zealand, are as yet principally employed in farming pursuits, as well as in dealing with the commodities that the country naturally produces. Their **manufacturing industries** are therefore not so extensive as they will be when the population has

increased considerably. Consequently the bulk of the iron and steel goods, and the woollens, cottons and other textiles that her people require are imported in large quantities, chiefly from the United States and Great Britain. For all that, Canadian manufactures are becoming increasingly important from year to year. Reapers and binders, and other agricultural machinery, are extensively made at Toronto and other places. Dairying and sawmilling, with their attendant industries, employ a great number of people. Ship-building is a prominent industry of the eastern provinces; while furniture, woollens, musical instruments, and wood-pulp, from which paper is manufactured, are also produced.

Quebec from the St. Lawrence River.

6. Provinces and Chief Towns.

1. Canada is divided into a number of Provinces and Territories. The local affairs of the Provinces are managed by the Provincial Parliaments, re-

sembling the State legislatures of Australia. The Territories* are controlled by the Dominion or Federal Parliament, which meets at **Ottawa**, the capital of the Dominion, and makes general laws for the whole of Canada.

2. The following is a list of the chief Canadian Provinces and Territories, with their capitals and chief towns. All the latter are connected with the railway systems of the Dominion: —

1. **Quebec—Quebec,** Montreal.
2. **Ontario—Toronto, Ottawa,** Hamilton, London.
3. **New Brunswick—Fredericton,** St. John, Moncton.
4. **Nova Scotia — Halifax,** Sydney.
5. **Prince Edward Island—Charlottetown.**
6. **British Columbia — Victoria,** Vancouver.
7. **Manitoba** (now extending to Hudson Bay)—**Winnipeg.**
8. **Saskatchewan—Regina.**
9. **Alberta—Edmonton,** Calgary.
10. **North-west Territories,** comprising — **Keewatin,** Mackenzie, Franklin.
11. **Yukon—Dawson.**

1. **Quebec** (124,000), on the St. Lawrence, is a city rich in historical interest, as around it were enacted those stirring scenes associated with the names of Wolfe and Montcalm, which marked the close of the French Empire in America. The inhabitants are principally of French descent and speak the French language. "The aspect of the city is Norman-French. Its architecture, scenery, fortifications, the look of the people, the language, all remind one of Normandy." Its citadel guards the entrance to the St. Lawrence.

2. **Montreal** (907,000), on an island in the St. Lawrence, at the head of the ocean-navigation of the river, and commanding the trade of the Great Lakes, is the largest city, and the chief port, of the Dominion. It was founded by Jacques Cartier (the

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*Compare Northern Territory in Australia.

discoverer of Canada), the great French explorer of the St. Lawrence and the Mississippi.

3. **Toronto** (522,000), the capital of Ontario Province, and Canada's largest manufacturing centre, owes its importance to its position on a fine harbour on Lake Ontario which makes it the natural outlet for the produce of an extensive district. It is the seat of the principal University of Canada.

Underwood and Underwood, photo

Montreal from Mount Royal, looking south-east towards the Victoria Bridge (1¾ miles long) by which traffic from Boston and New York reaches the city.

4. **Ottawa** (108,000), on the Ottawa River, a tributary of the St. Lawrence, is the capital of the

Dominion. The chief industry in the vicinity is lumbering.

5. **Winnipeg** (191,000), the capital of Manitoba, one of the great wheat-growing Provinces of Canada, has risen in, comparatively, a few years from a solitary hut to be the chief wheat trading centre of the Dominion.

6. **Vancouver** (117,000), is the chief port of Canada on the Pacific. It is the western terminus of the Canadian Pacific Railway and the Canadian Northern Railway, and the eastern terminus of the steamer lines from Australasia and the East. Opposite, on Vancouver Island, is **Victoria** (40,000), the capital of British Columbia.

7. **Halifax** (58,000), the capital of Nova Scotia, is the eastern terminus of the trans-continental railway systems, and the Atlantic port of Canada. Its fine and strongly fortified harbour is capable of holding all the navies of the world. Halifax is the chief British naval station in North America.

8. **Hamilton** (114,000), on Lake Ontario, is the commercial centre of the "garden of Canada," noted for its large yield of grapes, pears, peaches, and other fruit, much of which is canned or bottled. Owing to its manufactures of iron and steel goods it is called the "Birmingham of Canada."

9. Other Canadian towns of importance are **St. John,** the capital and seaport of New Brunswick: **Charlottetown**, the capital of Prince Edward Island; and **New Westminster,** the former capital of British Columbia. **London** and **Petrolia**, to the north of Lake Erie, have oil springs and petroleum refineries.

7. The People of Canada.

1. The majority of the people of the Dominion are of Anglo-Saxon origin; that is to say, they are mainly the descendants of English-speaking people who

settled in the country. In the Province of Quebec, however, most of the people are of Romance origin, and speak French. They are descended from the French who settled in Canada before it was wrested from France by the British in 1763. A large number of immigrants are arriving in Canada every year. These come chiefly from the British Isles, the United States, and Central Europe.

Union S.S. Coy. Ltd. photo

Where train and steamer meet. The C.P.R. station at Vancouver, B.C. This great railway company owns over 13,000 miles of railway lines and 8 million acres of land; it has its own telegraph system, hotels, and wheat elevators, as well as steamship services on both the North Atlantic and the North Pacific Oceans. Its headquarters are at Montreal, the eastern terminus of its railways.

8. Historical Outline.

(1) In 1497 John and Sebastian Cabot, in charge of an exploring expedition, sent out by Henry VII. of England, discovered the country by touching at Newfoundland and Labrador. In 1534, a French expedition, under the command of Jacques Cartier, sailed up the St. Lawrence River, past the sites of Quebec and Montreal, and took possession of

the country on behalf of the French King. Colonisation, however, was not begun until 70 years later, when Samuel Champlain, the actual founder of Quebec and Montreal, began his explorations and pushed forward his colonising schemes. Acadie (Nova Scotia) and Canada were then gradually settled by French colonists. In 1605 the first field of wheat was sown in Nova Scotia.

(2) A little later the Hudson Bay Company was founded in England, under the patronage of Prince Rupert, to develop the fur-trade of the far north-west; and forts and trading stations were established around Hudson Bay and the rivers flowing into it.

(3) For many years there were sharp contests between the English and French colonists of America, until the French troops were finally driven out of America by Wolfe, Amherst, and others, and Canada was ceded to the British in 1763.

(4) In 1841, Upper and Lower Canada were united under one Government; and in 1867 the Dominion was formed by the federation of Upper and Lower Canada (Ontario and Quebec), Nova Scotia, and New Brunswick. Other provinces were included in the federation from time to time, until now all of British North America, except Newfoundland, British Honduras, and the British West Indian Islands, are incorporated in the Dominion of Canada.

2. NEWFOUNDLAND.

1. Area, People, etc.

1. The British self-governing Colony of **Newfoundland**, includes the island of Newfoundland, which helps to form the Gulf of St. Lawrence; the Island of Anticosti, in the St. Lawrence Estuary; and a portion of the coast of Labrador. The **area** of the main island is a little less than that of the North Island of New Zealand, or about 42,000 square miles; and the **population** of the whole colony is about 259,000. Newfoundland is the nearest American land to Europe, and the American terminus of all the European cables.

"The inhabitants are chiefly located on the coast-line of the shores and bays, and the greater part are engaged in fishing—for cod in summer, and for seals in winter and spring; agriculture, mining, and lumbering are also engaging attention, and affording means of employment; while large pulp and paper mills are in operation. It is estimated that about one-third of the surface is covered with water. The climate is salubrious, but moist, and the people are a strong, healthy, hardy and industrious race."

2. The principal occupations of the people are those in connection with the **fishing** industry. The rivers team with salmon, and the coastal waters, and the **Grand Banks** of Newfoundland (some little distance away, in the Atlantic) form the largest and richest fishing grounds in the world. A large proportion of the fish caught are sent to Brazil, Portugal, and Spain. "Better half an acre of sea than a thousand acres of land," was a common saying in the early days of the colony.

Oats and **barley** are grown, but not wheat. The prevailing moisture (which is due to the condensation of the warm water vapour over the Gulf Stream by the cold air over the Arctic current—the two currents meeting near the eastern shores of Newfoundland) is favourable to the growth of pasture. and therefore to the promotion of the dairying industry. Timber, wood-pulp, paper, iron and copper are other prominent productions.

3. The chief town and port is **St. John's**, on the south-east coast. It has an excellent harbour, and great factories for preserving fish and for making cod-liver oil. It is also the headquarters of the sealing steamers that frequent the coastal and northern waters.

2. Historical Outline.

Newfoundland was discovered by Sebastian Cabot, in the employ of Henry VII. of England in 1497, and is therefore in one sense the oldest English colony. About sixty years later some English merchants formed a settlement to develop the fishing industry; while later still an unsuccessful attempt to colonise the island was made by Sir Walter Raleigh. In 1623 a settlement was formed on its shores by a number of Englishmen under Lord Baltimore. Subsequently the island was troubled by constant quarrels between the English settlers and the French fishermen, who resorted to its shores to cure their catches of fish. In 1713, by the Treaty of Utrecht, the island was declared to be British Territory, although the French fishermen still retain certain rights, which are even yet the source of dispute.

3. BRITISH WEST INDIES, HONDURAS, GUIANA, ETC.

The remaining British territory in America includes (1) the **British West Indies**, the most important islands being **Jamaica**, the **Bahamas**, **Barbados**, the **Bermudas** and **Trinidad**; (2) **British Honduras**; (3) **British Guiana**; and (4) several other small islands, such as the **Falkland Islands**, and South Georgia.

(1) **Jamaica** (Land of Wood and Water), is one of the most fruitful tropical islands in the world. In area it is nearly as large as the province of Hawke's Bay, and its population exceeds 850,000, most of whom are coloured. The chief **productions** are sugar, molasses, rum, coffee, spices and tropical fruits (bananas, coconuts and oranges). The capital and chief port is **Kingston**, on Port Royal Harbour.

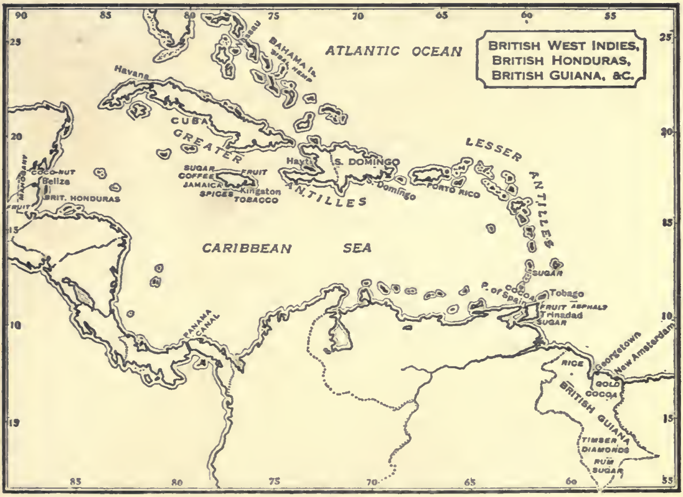
Jamaica was discovered by Columbus in 1494, and taken possession of by the Spaniards, from whom it was captured by two of Cromwell's Admirals. It is a British Crown Colony.

(2) The **Bahamas** (south-east of Florida Peninsula) consist of about 20 inhabited islands, and thousands of islets or keys. The chief town of the group is **Nassau** on the island of New Providence. The most important industries are the **sponge** and **turtle** fishing, and the growing of fibre plants, such as the agave, which yields **sisal hemp**. Fruit cultivation is increasing. The production of **salt** is also of importance.

(3) **Barbados**, a small island with a dense population, enjoying Representative Government, has been a British Colony

since 1625. Its chief **exports** are sugar, molasses, and rum. Cotton is also an important product. The capital and port is **Bridgetown.**

(4) The **Bermudas**, a cluster of about 360 small islands, only 15 of which are inhabited, do not strictly belong to the West Indian Group of Islands. They are situated in the Atlantic, a considerable distance from the mainland of America. The chief industry is market-gardening, the products of which (potatoes, onions, etc.) are exported to the United States. **Hamilton**, a British Naval Station, is the chief town.



(5) **Trinidad**, a large island off South America, a few miles to the north of the Orinoco delta, together with the smaller Island of Tobago, is a British Crown Colony. It was taken from the Spaniards in 1797. Inland, there is a rich deposit of pitch, 30 acres in extent, known as the Pitch or Asphalt Lake. The chief town is **Port of Spain** (64,000); and the most important **productions** are sugar, cocoa, coffee, molasses, rum, timber, fruit, coconuts, petroleum, and petrol. The population of the colony is nearly 400,000.

Tobago is better known as Robinson Crusoe's Island. Man Friday was a negro slave who had escaped from Trinidad.

(6) **British Honduras**, a Crown Colony, occupying the south-eastern portion of the Yucatan Peninsula, has an area of about half that of Canterbury, and a population (chiefly coloured) of 47,000. The chief products are mahogany, logwood and cedar. Rubber, sugar and indigo are also produced and exported. Tropical fruits grow in great abundance. The capital and only seaport is **Belize.**

(7) **British Guiana,** a Crown Colony on the north-east coast of South America, has an area of about 90,000 square miles. It is therefore nearly as large as New Zealand. Its population (chiefly coloured) exceeds 304,000. The climate is hot, but not generally unhealthy, the soil rich, the rainfall heavy, and the vegetation luxuriant. The chief products are sugar, rum, gold, diamonds, rice and timber. The chief town is **Georgetown** (56,000), on the Demerara, from which most of the produce of the country is exported.

British Guiana was originally a Dutch colony but was annexed to the British Empire in 1815, at the close of the Napoleonic wars.

(8) The **Falkland Islands,** in the South Atlantic, about 300 miles east of the Straits of Magellan, have a total area of less than half that of Canterbury. They were visited by Davis and Hawkins about 1593, were successively held by France and Spain, and became a British Crown Colony in 1832. They are occupied mainly by a few people engaged in sheep-farming or sea-faring industries. The chief productions are whale-oil, whale-bone, wool and sheepskins, which are exported. The only important settlement is **Stanley,** on the east coast of East Falkland. The population (chiefly British), including that of South Georgia, is under 4,000.

South Georgia, an island 600 miles to the eastward, with an area of 1000 square miles, is a dependency of the Falklands.

4. BRITISH TERRITORY IN AFRICA.

The Imperial Territory in Africa includes almost the whole of the southern portion of the continent, part of which forms the **Union of South Africa**; and portions of the **Central, Eastern,** and **Western** districts of the continent. In addition to these, the **Sudan** is under Anglo-Egyptian administration.

Egypt, for many years a semi-independent Turkish tributary-state, occupied by a British Force, became a British protectorate in 1914, but in 1922 was granted freedom from British rule. It is now an independent kingdom.

By the Treaty of Versailles, which closed the Great War, the South African Union was granted mandatory powers over German **South-west Africa**; and Great Britain was given a mandate over German **East Africa.**

1. THE UNION OF SOUTH AFRICA.

1. Provinces.

1. The Union of South Africa is a Federation comprising the following Provinces:—

PROVINCES.	CHIEF TOWNS.
1. **Cape of Good Hope** ..	**Cape Town, Kimberley, Port Elizabeth.**
2. **Natal*** ..	**Pietermaritzburg,† Durban.**
3. **Transvaal** ..	**Pretoria, Johannesburg.**
4. **Orange Free State** ..	**Bloemfontein.**

2. Government.

1. The affairs of the whole Union are in the hands of the Governor-General, appointed by the Crown; and the Union or Federal Parliament, which consists of a Senate mainly elected by the Provincial Legislatures, and a House of Assembly whose members are elected by the people of each Province.

The **Union Parliament** meets annually at **Cape Town,** which is the legislative capital of the Union; while **Pretoria** is the seat of the Executive Government, where the Ministers of the Crown usually reside, and where the principal Government offices are.

Each Province has a local Parliament, called **a Provincial Council,** to manage its affairs.

3. Area and Population.

1. The **area** of the four Provinces comprising the Union is nearly five times that of New Zealand,

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*The Portuguese name for Christmas. †Usually called Maritzburg.

or nearly half a million square miles. This is a little less than the area of the Northern Territory of Australia. The total population of the Union is about 7,500,000, of whom only one-fifth are white people; the remaining four-fifths being either natives, or other coloured people (including coolie labourers from India).

2. A large proportion of the white population, as we shall see directly, is of Dutch origin. Most of the remainder are of British descent. Both the English and Dutch languages are spoken in the Union, and either may be used in the Federal Parliament, or in the Provincial Councils.

4. Surface.

1. The diagram on page 183, which represents a section from south to north through the middle of the Cape Province, serves to illustrate the following facts regarding the relief of the country:—

(*a*) The Cape Province rises from the sea in three steps or terraces to the principal watershed, of which the Nieuwveld Range is a part.

(*b*) Each of the two higher terraces consists of a plateau having a mountain range running parallel to the coast as its southern edge.

(*c*) To the north of the Nieuwveld Range the country slopes gradually down to the bed of the Orange River, which forms part of the northern boundary of Cape Province.

The **coast terrace** is narrow and rises from sea level to the foot of the Coast Chain. The second terrace, called the **Little Karroo,*** is a long narrow belt of country from 40 to 50 miles wide, 200 miles long, and about 1000 feet high, lying between the Coast Chain and the Karroo Chain. The rainfall being moderate, this region abounds in vineyards, ostrich farms, and tobacco fields. The third and largest of the terraces, called the **Great Karroo,** is about 75 miles broad, 300 miles long and has an area a little smaller than that of Otago. It lies between the Zwart Bergen (Black Mountains) and the Nieuwveld Range and has an elevation of about 3,000 feet. It is covered with a yellow clayey soil, which, though arid and barren in the dry season, becomes carpeted with beautiful flowers and herbage after rain. It is mainly divided into farms, where sheep (merino), cattle, angora goats,* or ostriches are reared. Open country is called **veldt** in South Africa.

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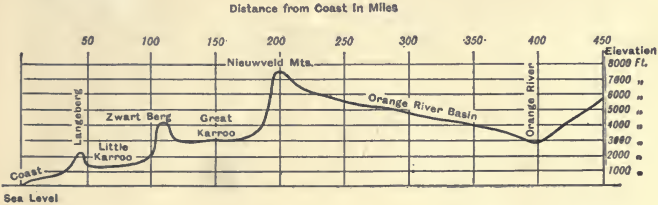
*Karroo = dry.



After Whiteside

A north and south section across South Africa.

2. Natal, a well watered Province, also rises from the sea to the mountains (Drakenberg Mountains), in three terraces. These are the **Coast**, the **Midland** Terrace, and the **Uplands,** each of which has its own special climate and products. The larger part of the Transvaal Province lies to the west of the Drakenberg Mountains, and slopes from them towards the **Limpopo River** and Bechuanaland. A smaller portion slopes from the eastern faces of the Drakenbergs towards the Indian Ocean. Steppes† and bush predominate, favouring the growth of pastoral industries. The greater portion of the surface of the Orange Free State Province consists of an undulating plateau.

3. The **rivers** of South Africa are numerous, but are usually of inconsiderable size. They run mainly

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*The hair of these goats, which is long and silky, is called *mohair.*

†Grassy plains or plateaus.

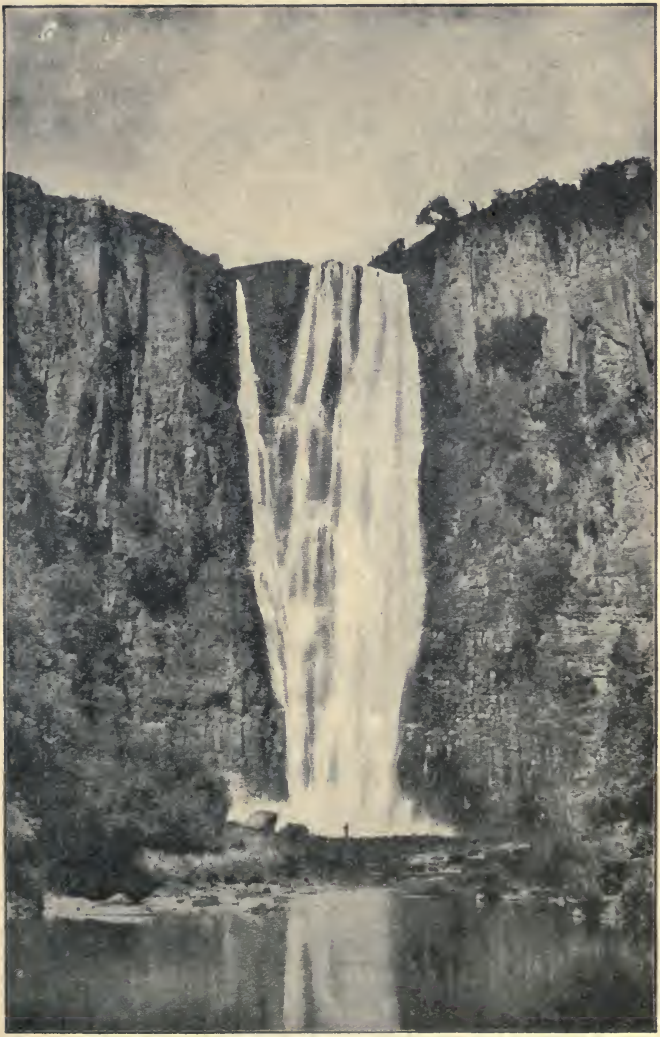
in the rainy seasons, and are not navigable for any distance. The largest is the **Orange River** (about 1000 miles in length), whose tributary the **Vaal**, forms part of the boundary between the Transvaal and Orange Free State Provinces. It flows through a rich gold-bearing country, and the diamond fields, into the Atlantic. The **Limpopo** forms the northern boundary of the Transvaal, and, after making a great curve of over a thousand miles, reaches the Indian Ocean. Other rivers of importance are the **Olifants**, the **Great Fish River**, and the **Tugela**.

5. Commercial Position.

1. The South African Union occupies a splendid commercial position, lying as it does in the middle of the direct trading route for sailing vessels, and tramp steamers, between Europe, India. China, Japan, Australia and New Zealand. Important lines of steamers from England to Australia call at Cape Town. Through its southern ports the Union can trade as readily with Europe and America, as with Asia, Australia, and New Zealand.

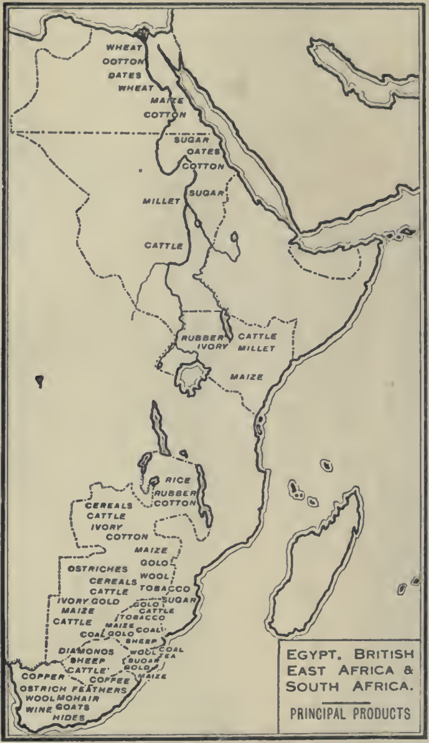
6. Climate.

1. The northern part of the Union lies just beyond the Tropic of Capricorn, and the southern extremity extends to a point about eleven degrees south of it. The greater part of the country therefore lies in a warm temperate region, the temperature decreasing from north to south. The rainfall is heaviest on the eastern and south-western coasts, and decreases towards the interior. Over a large area in the west the rainfall does not exceed 10 inches.



Waterfalls, Natal. The illustration is typical of the manner in which South African rivers reach the coastal plain.

7. Industries and Commerce.



EGYPT. BRITISH EAST AFRICA & SOUTH AFRICA.

PRINCIPAL PRODUCTS

1. The South African Union contains large areas of fertile land that is very productive where the rainfall is sufficient, or where irrigation works have been established. The warm and moist coastal strip on the east is favourable for the growth of tropical plants. **Coffee, sugar, tea and tobacco** are grown in the coastal region of Natal, and maize on the cooler uplands. **Sheep farming**, and cattle and **goat raising** are important industries throughout the country. Upon the terraces or Karroos, and over the grassy uplands of the Orange Free State Province, the production of **wool** is steadily increasing. **Ostrich** farms are numerous in the Cape of Good Hope and Transvaal Provinces: ostrich feathers forming a valuable export.

2. The principal wealth, however, of the Union, at present lies in its rich mineral resources. The

Transvaal is the greatest **gold** producing country in the world. The principal mines are located round about **Johannesburg.** The gold seems to be **evenly** distributed throughout the reefs, which **although** they do not produce a large quantity of gold to the ton, yet yield regular results that can always be relied upon. The richest **diamond** mines in the world are found in and around **Kimberley,** in the Cape Province. **Coal** is mined in the Cape Province, the Transvaal, and Natal.

Underwood and Underwood, photo

Plucking an Ostrich, South Africa.

The chief export and import trade of South Africa is carried on with Great Britain. Wheat, flour, meats, butter, gold specie, machinery are imported from Australia. The Union's trade with New Zealand is confined to exports of tanning-bark, maize, precious stones, and wine.

8. Internal Communication.

1. As the South African Rivers are of little use for the transport of goods, about 11,500 miles of railway have been laid down to connect the ports with the chief producing centres of the interior. The main line proceeds from Cape Town through the Orange Free State, the Transvaal, and Rhodesia, and crosses the Zambesi at Victoria Falls; the intention being to form a transcontinental line to Cairo in Egypt. Other main and branch lines proceed to the inland towns from Port Elizabeth, and Durban; and from Lorenzo Marquez, on Delagoa Bay, and Beira, both of which are in Portuguese territory.

9. Historical Outline.

1. The country was discovered by the Portuguese at the end of the 15th century during their attempts to find a sea route to India. A settlement was formed at Cape Town by the Dutch in the middle of the 17th century, to serve as a port of call for the vessels of their East Indian merchant fleet. Cape Town was captured by the British during the Napoleonic wars, and after the battle of Waterloo, in 1815, the district was recognised as a British colony.

2. Later on, many of the Boers (Dutch farmers), who disliked the British chiefly because they had abolished slavery, and so set free the slaves on whose work the Dutch settlers chiefly relied, crossed the Orange River and formed a Republic called the Orange Free State. Others "trekked" into Natal, and settled on land they had seized from the Zulus. Later on, when the British annexed Natal, many of these crossed the Vaal River, and set up the Transvaal Republic. At the request of a large number of the inhabitants, this territory was annexed by the British in 1877; but afte

a short war, in which some British troops were defeated at **Majuba Hill,** Great Britain acknowledged the independence of the Transvaal, subject to her own right of controlling foreign affairs.

3. The Boers continued to govern their two republics until 1899, when, owing to the manner in which British subjects were treated in the Transvaal, war again broke out with the British. After a long and severe struggle, in which soldiers from New Zealand, Australia, Canada, and other parts of the Empire rendered good service, the Transvaal and the Orange Free State again became British territory. In 1910 the Union of South Africa was formed; the four original colonies agreeing to federate, and to become provinces of the Union under the names already indicated. Under the constitution, provision is made for the admission of Rhodesia to the Union, when desirable, and for the transfer to the Union Government of the administration of protected and other native territories.

10. Chief Towns.

1. **Cape Town,** on Table Bay, including its suburbs has a population of 207,000. It is the legislative capital, and the chief port and commercial centre of the Union. It is also the capital of the Cape of Good Hope Province. Near it is the flat-topped **Table Mountain,** which the mists sometimes overlap and cover so as to resemble a tablecloth. Cape Town is the southern terminus of the principal railways. Near it is **Simonstown,** a British naval station.

2. **Johannesburg** (288,000), in the Transvaal, is the greatest gold-mining centre in the world.

3. **Durban** (146,000), is the chief port of Natal. **Pietermaritzberg** (36,000) (commonly called Maritzburg), on the second terrace, is the capital. Further inland still, on the third terrace, is the coal-mining centre of **Newcastle.**

4. **Pretoria** (74,000), is the capital of the Transvaal Province, and the executive capital of the Union.

Underwood and Underwood, photo

Cape Town and Table Mountain.

5. **Kimberley** (40,000), the largest inland town in the Cape Province, is the greatest diamond producing centre in the world.

6. **Port Elizabeth** (46,000) and **East London** (35,000) are leading sea-ports of the Cape Province.

7. **Bloemfontein** (= Flower fountain) (40,000), on a tributary of the Modder River, is the capital of the Orange Free State Province, and the seat of the

Supreme Court of the Union. Its position in the heart of a plateau renders its climate remarkable for its dryness and its extremes of heat and cold.

11. Protectorate of South-west Africa.

This region, having an area of 322,000 sq. miles, and formerly named German South-West Africa, was wrested from Germany by Union forces under General Botha in 1915. It is now governed by the Union of South Africa under a mandate from the League of Nations. The chief town is **Windhoek**, and the chief port is Swakopmund, both connected by rail with the Union railway system. Pastoral occupations are of primary importance, and diamond mining is proving highly profitable. (See Walvis Bay, page 195).

2. RHODESIA, ETC.

1. **Rhodesia**, the affairs of which were formerly under the control of the British South Africa Company, formed by the great imperial statesman, Cecil Rhodes, lies to the north of the Transvaal. It is divided into **Northern** and **Southern** Rhodesia, and has an area of about 440,000 square miles (more than four times that of New Zealand), and a population (almost wholly native) of over two millions. Situated within the Tropics, and having a good rainfall, it has a tropical vegetation. Rubber, cotton, sugar, rice, ivory, gold, and other minerals, are exported. Maize is widely grown. Its native animals include lions, elephants, the hippopotamus, and many kinds of antelope, but these are fast disappearing before the increase of settlement.

In 1923 **Southern Rhodesia** became a self-governing colony, its people having in the previous year voted against joining the Union of South Africa. The colony lies south of the Zambesi, and includes the two districts of **Matabeland** and **Mashonaland**. The chief town of the former is **Bulawayo**, and of the latter, **Salisbury**, which is also the seat of government. The Cape to Cairo Railway passes through these towns, and at present reaches beyond the Zambesi River and into the Belgian Congo.

In 1924 **Northern Rhodesia** was removed from the control of the British South Africa Company and became a British Protectorate.

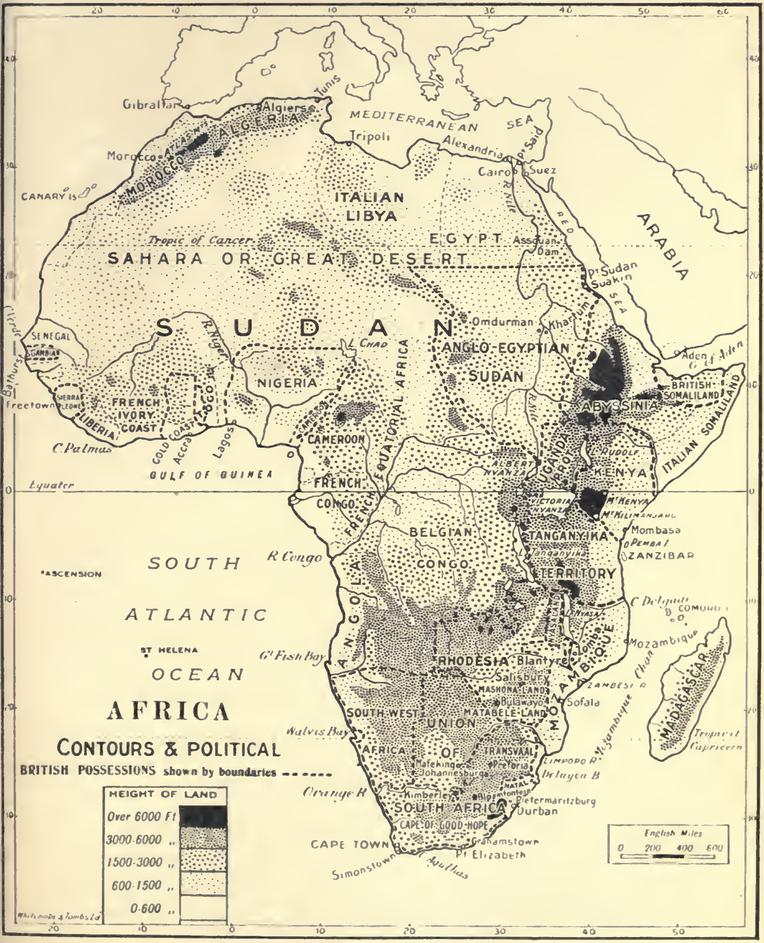
2. The **Bechuanaland Protectorate** occupies a central position between the South African Union, Rhodesia, and German South-West Africa. It has an area of 275,000 square miles, and is sparsely inhabited by natives and white people. Cattle form the chief wealth of the country. The chief town is **Mafeking**, on the Transvaal border, famous for its siege during the Great Boer War. Cattle and sheep rearing, and the cultivation of maize and Kaffir corn are the chief industries.

3. **Basutoland** is a native territory of British South Africa, lying between Natal, the Orange Free State Province, and the Cape Province. Though elevated and rugged it has a fine climate, and includes the best wheat-growing and pasture lands in South Africa. It exports grain to the Union, and wool to Great Britain.

4. **Swaziland**, to the south-east of the Transvaal, inhabited chiefly by natives, is under the control of Great Britain. The agricultural products are maize, millet, nuts, and sweet potatoes, grown chiefly for local supply. Tobacco and cotton are also cultivated. Alluvial tin and also gold are being mined and exported.

5. **Nyasaland Protectorate** (formerly known as the British Central Africa Protectorate) lies to the west and south of Lake Nyasa. The chief occupations of the British settlers are cotton, tobacco, rubber, tea and coffee planting. Ivory and bees' wax are also exported. **Blantyre** and **Zomba** (the

headquarters of the Government) are the chief towns.



3. BRITISH EAST AFRICA.

The British East African territory includes the **Kenya Colony** (chief products, cattle, sheep, ostrich feathers, cereals, ivory, rubber, wattle bark, and cotton); chief town and port, Mombasa (32,000), though Nairobi, inland on the Uganda railway is the capital; the **Uganda Protectorate** (principal exports: cotton, ivory, skins, sugar, coffee, rubber) seat of the British administration, **Entebbe**; the **Zanzibar Protectorate** (chief products: cloves, copra, chillies, ivory, rubber, hides, and gum) includes the islands of Zanzibar and Pemba; a portion of former German East Africa, finally conquered in 1918, mandated to Great Britain, now named **Tanganyika Territory**; area about 365,000 sq. miles, lying west of Zanzibar and east of Belgian Congo, having a population of over 4 million; chief town and port, **Dar-es-Salaam,** from which a railway runs to Ujiji on Lake Tanganyika; products vary with elevation, chief products being sisal, cotton, hides, copra, wax, ghee, ground nuts, rubber, and ivory; the **Somaliland Protectorate** (main products: cattle, sheep, coffee, skins, hides, ostrich feathers, ivory, and gum), the chief town of which is **Berbera** (30,000); the island of **Mauritius**, a Crown Colony in the Indian Ocean (capital and chief port, **Port Louis**; chief productions, sugar, rum, vanilla, molasses, spice, and coco-nut oil); and several other groups of islands off the eastern coast.

4. BRITISH WEST AFRICA.

1. The British West African territory comprises several Crown Colonies and Protectorates located along the western shores. The principal of these are:—**Gambia** (capital **Bathurst**; chief productions, ground nuts, hides, palm kernels, beeswax, rubber); **Gold Coast Colony**, including Ashanti, (chief town

Accra; principal products, palm oil, gold, palm-kernels, rubber, cocoa, and timber); **Sierra Leone,** (capital **Freetown**; chief exports, palm oil and kernels, kola nuts, rubber, hides and ginger); and the colony and protectorate of **Nigeria**, watered by the Niger and its tributaries, having a combined area of about 3½ times that of New Zealand, and a native population of over 18,000,000. Their chief exports are palm oil and kernels, mahogany, gums, ivory, cotton, cocoa, sugar, rubber, and tin. The principal town and port is **Lagos.** Several hundred of miles of railway, constructed by the British, run inland to different parts.

2. **Togoland** and **Cameroon,** which were wrested from Germany in 1914 and 1916 respectively, have been divided as mandates with France. Of the former Britain obtained about one-third, or 12,600 sq. miles, and of the latter about one-sixth or 33,000 sq. miles. The chief products of each are palm oil, palm kernels, cocoa, rubber, coffee, spices, raw cotton, and cattle.

3. The British Islands of **Ascension** and **St. Helena,** lie in the South Atlantic from 1,200 to 1,500 miles from the West African Coast. The latter is famous for being the residence of the emperor Napoleon during his exile in 1815-1821. New Zealand flax is cultivated on the island. Its capital, **Jamestown,** is an Admiralty coaling station. Both Islands are important cable stations.

4. **Walvis Bay** is a small British settlement on the West Coast, surrounded by former German territory. It is a free port on the only good harbour on that part of the coast; consequently much of the trade of South-West Africa Protectorate has to pass

through it. Its affairs are accordingly now administered by South-West Africa.

5. EGYPT AND THE SUDAN.

1. Egypt has been freed from British rule so recently and the interests of Englishmen there are so important that the country can hardly be ignored in an account of the British Empire.

2. Egypt proper is the country occupying the north-eastern corner of Africa. It includes the delta lands of the Nile, and both banks of the river as far south as Wady Halfa. Its **area** is about 12,000 square miles; but, including the Libyan Desert to the west, the total area of Egypt is about 350,000 square miles (exclusive of the Sudanese Provinces). The **population** is over 14 millions. It is divided into Upper Egypt and Lower Egypt. The area of the **Anglo-Egyptian Sudan** is estimated at a little more than a million square miles, and the population at nearly 6½ millions.

A regular fortnightly air service is in operation from Cairo to Palestine and Iraq. Another service connects Cairo and Karachi in India.

3. Egypt is almost wholly an agricultural country; but its commercial importance and prosperity have greatly increased since the opening of the **Suez Canal** in 1869. This great highway of commerce, about 100 miles in length, is on the main trade route between Great Britain and Western Europe and India, China, and other eastern countries; as well as on the mail route between England and Australia. The British Government practically controls the canal, and three-fifths of the vessels passing through it fly the British flag.

4. The **Nile** is the great fertiliser of Egypt, without which the greater part of the country would

be a barren waste, as rain rarely falls there. Owing to the heavy rainfall regularly every year on the Abyssinian Mountains, the river with unfailing regularity rises from June till October, until its level at Cairo is about 26 feet above that of low water. During the flooding, the Nile overflows its banks and annually deposits on either side a rich coating of loam, that, when the river subsides, grows splendid crops of **cotton, rice, wheat, maize, sugar-cane,** etc. These form the staple products of Egypt; the annual flooding of the Nile making it one of the richest agricultural countries in the world. British capital and enterprise have further irrigated the country by making canals, dams, and other irrigation works. The **Assouan Dam,** for instance, and others, built by British engineers, form huge reser-

Assouan Dam, in the Nile River, stores over 2.500 million cubic yards of water. It is 1¼ miles long, 129 ft. high, 80 ft. thick at the base, 66 feet thick at the top, and is well-provided with flood gates to control the flow of water, and with locks to allow for the passage of shipping.

voirs which enable a great area in Middle Egypt to be irrigated when the river is in flood, and ensures a supply of water for irrigation purposes when the tropical rains are below the average. The **Sennar** dam on the Blue Nile in Anglo-Egyptian Sudan, has brought a vast area into close cultivation (cotton and corn).

There are three seasons or crops in the year. Wheat and other cereals are winter crops; cotton, sugar, and rice are summer crops; rice, maize, millet and vegetables are autumn crops. Where irrigation is perennial, as in Lower Egypt (delta region) two and even three crops are obtained from the same soil in the year.

Towns of Egypt and the Sudan.

(1) The **capital** of Egypt is **Cairo** (790,000), at the apex of the Nile delta; and the chief **ports** are **Alexandria** (444,000), on the Mediterranean, at one of the mouths of the Nile, which exports cotton and cereals; **Port Said** (91,000), the Mediterranean terminus of the Canal; and **Suez**, the Red Sea terminus.

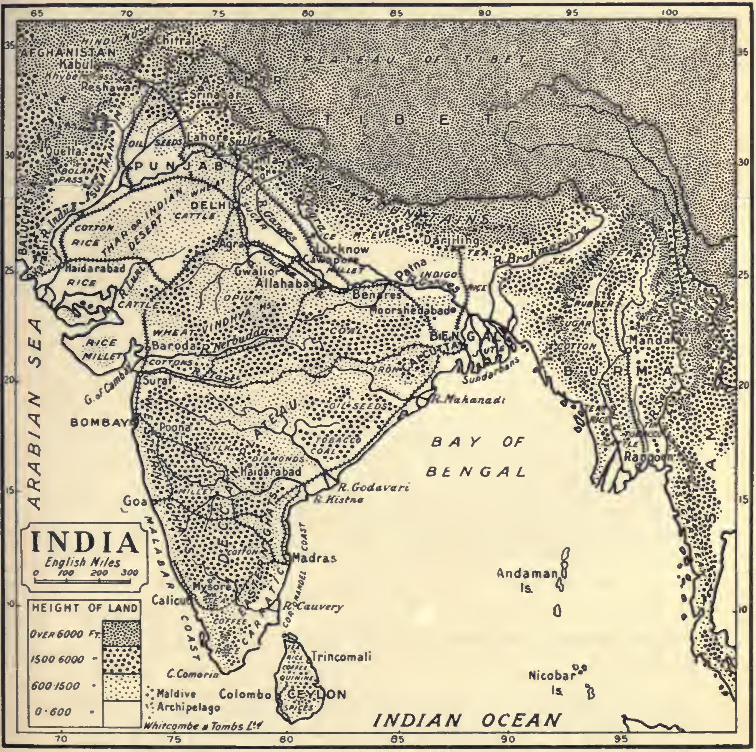
(2) As already stated, the area of **Anglo-Egyptian Sudan**, finally conquered in 1899, and now controlled by the British and Egyptian Governments, is about a million square miles, while their population is nearly 6½ millions. The capital is **Khartum** (with suburbs, 30,000), on the Nile, ever to be associated with the name of General Gordon. Opposite is **Omdurman** (78,000) where the Anglo-Egyptian forces, under General Kitchener, finally defeated the Khalifa, the then tyrannical ruler of the Sudan. Port Sudan and Suakin are small ports on the Red Sea.

5. BRITISH TERRITORY IN ASIA.

1. THE INDIAN EMPIRE.

1. Position and Area.

Continental and peninsular India, which includes a number of native States more or less dependent on, or controlled by, the Imperial Government, extends from the Pamir Plateau and the Himalayas to Cape Comorin. Its land boundaries on the west, north, north-east and east respectively, are Persia, Afghanistan, Soviet Central Asia, the Chinese Republic, French Indo-China,



and Siam. The Indian Ocean, including the Arabian Sea and the Bay of Bengal, washes its long coastline.

Including Burma and the native States, the area of India is roughly 1,800,000 square miles, or about 18 times that of New Zealand. Its total population is about 325 millions.

2. Commercial Position.

1. India occupies one of the finest commercial positions in Asia. With its long stretch of coastline extending far into the Indian Ocean, it stands midway on the trading route between Western Europe, Africa, and Australia. It is near the productive islands of the East Indian Archipelago, and is conveniently situated for trade with China, Japan, Australia and New Zealand. To and from its shores large steamers trade regularly, through the Suez Canal, with the ports of Great Britain and continental Europe, or across the eastern seas with Australasia and eastern Asia. Sailing vessels proceed to and from Britain by way of the Cape of Good Hope. Its vast internal resources, and its commercial position make it a country of extensive trade.

3. Surface.

1. The surface of India comprises (1) the mountainous Himalayan region; (2) the northern river plains; (3) the southern tableland forming the Deccan Peninsula; (4) the eastern and western coastal plains; (5) the mountains of Burma; and (6) the alluvial plain of Burma. The giant **Himalayas** (through which there are no practicable passes), with their southern spurs and valleys, occupy a considerable portion of Northern India. The Khyber and Bolan Passes are the principal entrances through the **Sulaiman Mountains** into the valley of the Indus on the West. To the south and west of these ranges stretch the great fertile plains of the Ganges and the Indus, separated from each other by the Thar or Great Indian Desert. The **Eastern** and **Western Ghats** form the faces of the Deccan Plateau, the latter much the higher, fronting narrow plains on

the Malabar and Carnatic coasts bordered by the sea. The **Vindhya Hills** form the northern scarp of this tableland. Burma consists for the most part of interior highlands, broken by wide river valleys. Dense forests and marshlands frequently occur. The delta formed by the Ganges and Brahmaputra includes large swampy jungles, known as Sundarban (forest), through which these rivers in numerous streams reach the sea.

Colombo Breakwater during the South-west Monsoon.

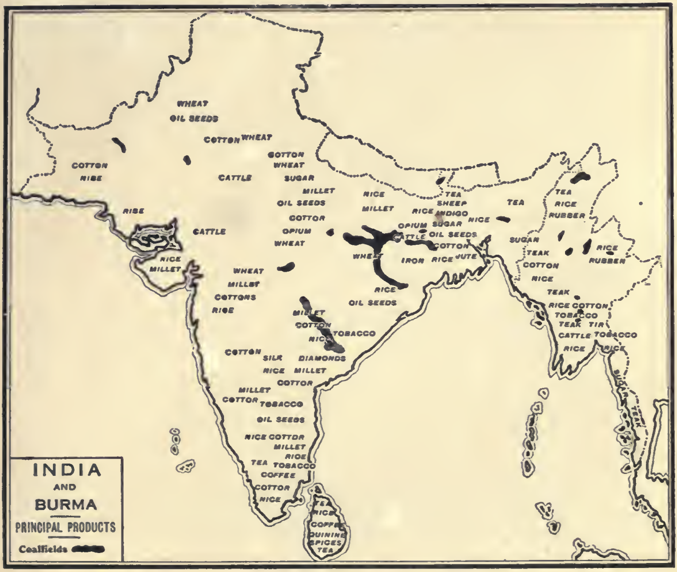
2. The great rivers traversing the densely populated northern plains are the **Indus**, the **Ganges**, and the **Brahmaputra.** Through Burma, the **Irawadi**, and the **Salwin** flow southwards into the Bay of Bengal. Through Southern India, the Nerbudda and the Tapti flow westwards into the Arabian Sea; while the Mahanadi, the Godavari, Kistna, and Cauvery take an easterly direction to the Bay of Bengal.

4. Internal Communication.

The Ganges and Indus, with their connecting irrigation canals, form great natural highways for the carriage of merchandise. Owing to British enterprise, a network of roads and railways traverses the country, connecting Peshawar and other places in the far north-west with Calcutta in the east, and with Bombay and Madras in the south. By means of the roads, rivers, canals, and railways, all parts of India are now within easy communication with one another; so that the vast inland trade is now carried on more readily than formerly.

5. Climate.

India is situated (roughly) between the 8th and 35th parallels of north latitude, and therefore has the Tropic of Cancer passing through its central area. Its climate, however, although on the whole very warm, is more varied than one would suppose from its situation. The northern region and the Deccan Plateau are of considerable elevation, a circumstance which renders the climate cooler than in other parts. In the plain watered by the Indus and the Ganges the climate is extremely warm, and generally unpleasant for Europeans. The temperature is more uniform on the coast than in the hot sheltered inland valleys. The great mountain barrier in the north, shelters India from the cold winds that blow across the icy steppes of Central Asia; while they condense the copious moisture brought by the southerly monsoonal winds from the Indian Ocean, thus giving rise to such great rivers as the Indus, Ganges, and Brahmaputra. There is no real winter in India, except in the higher country, the seasons being the **hot**, the **rainy**, and the **cool**. The seasons depend mainly on the north-east, and the south-west **monsoons.** The former sheds what little moisture it has on the northern slopes of the **Himalayas,** and passes over India as a dry, warm wind. The latter discharges a heavy rainfall upon the Western Ghats, and upon the mountains in the north-east. The hot season lasts from March till June; the rainy season from June till October; the cool season from October till March.



6. Industries and Commerce.

1. Quite two-thirds of the people of India are engaged in **agricultural** pursuits. The most important food-plants grown are **millet, rice,** and **wheat.** Millet, which forms the chief food of the native population in the cooler parts of India, is

largely grown in the Indo-Gangetic plain, and in the southern peninsula. **Rice**, which requires a hot, moist climate, is cultivated principally in the Ganges delta—the rice-fields occupying an area nearly as large as New Zealand. **Wheat** is extensively grown in the Indus basin of the north-west, and in the Central provinces, and is largely exported to Great Britain. **Tea**, the greater portion of which is exported to Great Britain and Australasia, is produced in great quantities in Assam and Bengal. **Indigo**, and **opium** (obtained from the seeds of the poppy) are largely produced in the Ganges basin. The cultivation of opium is now a Government monopoly, but its production is limited under an agreement with China to restrict the output. The Government receives the crop, and manufactures it for the foreign market in the factories of **Patna** and **Ghazipur**.

Valuable **timbers**, such as teak and sal, the useful bamboo, and the cinchona tree (from which **quinine** is obtained) are grown. Special attention is paid to **afforestation**; the Forest Departments having under their control huge forest tracts that exceed New Zealand in area.

2. After the United States of America, India is the most important **cotton** producing country in the world. The cotton plant is grown extensively in the Deccan peninsula, where the soil and climate are particularly favourable for its successful cultivation. Much of the raw cotton is exported to Great Britain; but considerable quantities are manufactured in the cotton factories of Bombay and other places. India supplies the world with **jute**, which is grown chiefly on the Indo-Gangetic plain. **Silk** is an important production of the Bengal Province. Cashmere **shawls**, woven by the natives

from goats' wool, are produced in the Province of Kashmir, situated in a valley of the Himalayas.

3. **India** has considerable mineral resources. Large deposits of **coal** and **iron** are found, chiefly in Bengal. **Petroleum** occurs in considerable quantities, chiefly in Burma. Diamonds, and other precious stones are still obtained from the river gravels of many parts of the country. The principal mineral, however, is **salt**, the production of which is in the hands of the Government.

Bamboos, common in the Asiatic parts of the British Empire.

4. Owing to the cheapness of labour, the abundance of raw material, and the pressing needs of a dense population, the manufactures have been growing steadily of late years. The wearing material used by the Indians consists principally of

cotton garments manufactured in the cotton mills of Bombay and other places. **Jute** factories are in operation in the Ganges basin. The Indians have always been celebrated for the delicacy and beauty of their workmanship, and the brilliance of their dyes. Their hand-made goods are especially valuable; such as the shawls of Kashmir; the silks and carpets of Moorshedabad; as well as muslins, chintzes, embroideries, gold-brocade, ivory carvings, and metal ornaments.

5. The **commerce** of India is on an extensive scale; three-fifths of the imports coming from Great Britain, and one-fifth of the exports going to the same country: the total trade being of the value of considerably more than 450 millions sterling. After Great Britain, the chief trade is carried on with Eastern Asia, United States, Germany, France, and Italy. The chief **exports** are rice, wheat, flour, raw cotton, opium, and oil-seeds, hides, jute, tea, wool, rubber, dyes, and coffee. The chief **imports** are cotton goods, machinery, and other metal goods, sugar, oils, motor vehicles, silks, woollens, and salt.

7. Government.

The government and administration of Indian affairs are really in the hands of the British Parliament, and only to a slight extent in the hands of the people of India. India is styled a **Dependency** of the Empire, and his Majesty the King holds the title of Emperor of India, or Kaiser-I-Hind. The executive government is controlled by the Viceroy, or Governor-General, assisted by a Council, both appointed by the British Government. In England, the head of the Indian Department is the Secretary of State for India. who is also assisted by a Council.

The **Native or Feudatory States** are governed by their native princes, who, nevertheless are assisted in their administration by a British Resident appointed by the Viceroy. They are not allowed to make war, nor to send ambassadors to foreign States.

The Indian Army consists of about 62,000 British regulars, 192,000 native troops, and some 34,000 volunteers. The chief officers of the native troops are British.

8. Historical Outline.

1. In very early times, long before the Christian Era, a race known as Aryans, living beyond the Hindu Kush Mountains, penetrated the Khyber Pass and settled in the basins of the Indus and Ganges, displacing the former inhabitants. Some of their sacred songs, or Vedas, are still in existence; and their later religion, Brahminism, is still followed by more than 200 million Hindus. Alexander the Great and his Greeks, coming by the same route, conquered a portion of the country, but did not remain long enough to make permanent settlements. In the Middle Ages, the Persians formed Mohammedan settlements in the north; and, later, the Saracens founded the Mogul Empire over the greater part of India. Their capital was established at Delhi, the present Imperial capital; and they imposed their laws, and to some extent their religion, on the conquered races.

2. In all the earlier invasions the conquerors came through the mountain passes; but, subsequently the foreign settlements were made from the sea by Europeans. In the 16th century, as a result of the discovery of the Cape route to India, the Portuguese established settlements on the west coast· Goa, which is still Portuguese territory, being the principal one. They were followed by the Dutch, the French, and the British.

3. The Mahrattas, a powerful and warlike race from the north, displaced the Mogul emperors, and they in their turn were conquered by Clive and the soldiers of the British East India Company. A fierce struggle with the French in the eighteenth century, left the English company masters of the greater part of India. In 1857 the native soldiers of the East India Company mutinied; and after the suppression of this wide-spread revolt, which is known as the Indian Mutiny, the British Government took full

control of Indian affairs. In 1876 Queen Victoria was made Empress of India; and our present King is now Emperor of India. The names of Clive, Warren Hastings, Wellesley, Nicholson, Havelock, Outram, and others are inseparably associated with the history of India under British rule.

4. Altogether, nearly 150 languages are spoken in different parts of India, the literary language being known as Hindustani; itself forming the spoken language of some 60 million people. Of the people, over 200 millions are Hindus, or Brahmins, who profess the Brahminical religion; nearly 70 millions are Mohammedans; about 11 millions (mostly in Burma) are Buddhists; some 4 millions are Christians; while the remainder profess various beliefs.

5. The European population is very small, and consists principally of the officers and soldiers of the British army. and the chief officials connected with the civil government of the country. Altogether, it does not number a quarter of a million people.

9. Chief Cities and Ports.

1. The great cities of India have been famous from very early times. The largest of them are situated on the basins of the Ganges and Indus. The density of their population is some evidence of the productiveness of the soil, of the quantities of food grown. and of the importance of the industries carried on. The **capital** is **Delhi**; and the principal ports are Calcutta. Bombay. Madras, and Karachi.

(1) **Delhi** (304,000), on the Jumna, a tributary of the Ganges, is the political capital of India. It was formerly the capital of the Mogul Empire, and is still the centre of the Moslem world in India. It is a great centre of trade, and is famous for its siege during the Indian mutiny.

(2) **Calcutta** (1,327,000), on the Hugli, one of the mouths of the Ganges, is one of the chief ports, and until recently was the capital of British India. It is the third largest town in the British Empire, and is the great emporium from which both home and foreign goods are distributed.

(3) **Bombay** (1,175,000), on the Malabar (west) coast, is the second largest town in the British Empire. It is the busiest port, and occupies the finest commercial position in Asia. It is also a great manufacturing city; cotton-spinning dyeing, and the making of cotton and copper goods being amongst its leading industries. It is also a great grain port

(4) **Madras** (526,000), on the Coromandel (east) coast, is the third largest town and sea-port of India. **Rangoon** (342,000), in Burma, near the mouth of the Irrawadi, after Calcutta, is the busiest port on the Bay of Bengal. **Karachi** (216,000), on an excellent harbour at the mouth of the Indus, is the outlet for the produce of the Indus Valley, and exports large quantities of wheat. **Peshawar**, on the north-west frontier, is a strong British military post defending the entrance to the Khyber Pass. **Lahore** (281,000), in the Indus Valley, the capital of the Punjab, is an important railway centre.

Bombay Harbour

(5) Besides Calcutta, the principal towns on the Ganges basin are:—**Patna**, the centre of a great opium, and rice-growing district; **Benares**, the sacred city of the Hindoos; **Allahabad**, at the junction of railway lines from Bombay, Calcutta, and the north-west; and **Agra**, famous for its marble temple, known as the Taj Mahal. **Lucknow** and **Cawnpore**, also on the Ganges basin, are of historical importance for the part they played in the Indian Mutiny. **Simla** on the southern slopes of the Himalayas is a sanatorium and resort of Europeans during the summer months.

2. OTHER BRITISH TERRITORY IN ASIA.*

1. **Ceylon**, a pear-shaped island almost joined to Southern India by a chain of reefs and sandbanks, known as Adam's Bridge (across which a viaduct is now being constructed), is a British Crown Colony. Its **area** is about the same as that of Otago and its **population** is nearly four times that of New Zealand. The native inhabitants are called

Underwood and Underwood, photo

Simla, the beautiful Himalayan Mountain summer resort for the European residents of India.

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*See Map of the World facing page 161

Cingalese. The country is mountainous, the highest peak being about 8,000 feet high; but it contains no rivers of importance.

The capital and port is **Colombo** (244,000), a port of call for Australian steamers to Britain *viâ* the Suez Canal. The chief products are tea, rubber, coco-oil, copra, grain, rice, cinnamon, cacao, and coffee. The island was first colonised by the Portuguese, then by the Dutch, and passed into the hands of the British in tho 18th century. The **Maldive** Archipelago forms a dependency of Ceylon.

2. **Aden**, a town and territory on the south-west coast of Arabia near the Straits of Bab-el-Mandeb, is a strongly fortified coaling station for the British navy, and a place of considerable mercantile and strategic importance, as it commands the southern entrance to the Red Sea. **Perim Island** (a coaling station for the British mercantile marine), and **Socotra** (off the African Coast) are dependencies of Aden.

3. **Hong Kong**, an island and Crown Colony in China, near the mouth of the Canton River, is a British military and naval station with a strong Imperial garrison. The capital **Victoria** (465,000), commonly called Hong Kong, is a free port, and the great emporium for the European trade with China. It has a University, opened in 1912 under the patronage of King George V. The **imports**, chiefly goods for China, include cottons, opium, coals, iron and steel. The chief **exports** are tea, silk, rice, and other Chinese produce.

4. The **Straits Settlements**, a British Crown Colony in the Malay Peninsula, include the island and town of Singapore; some territory on the mainland; and Labuan, off the north coast of Borneo. The **Federated Malay States**, on the **mainland**, are under British protection. The chief productions of the Straits Settlements are rubber, tin, copra, pepper, sugar, rice, sago, tapioca, spices, dye-stuffs, coffee, tobacco, gums, and hides.

Singapore, the capital of the Straits Settlements, is a free port, and one of the greatest shipping ports in the world, being a port of call for vessels trading between Europe or India and the Far East, Northern Australia, and the Dutch Indies. It is strongly fortified, and is garrisoned by a British force. Its defences and shipping facilities are now being improved and brought up to date to adapt it for a modern naval base.

Dredging for Tin, Straits Settlements.

5. **Sarawak,** is a portion of British territory on the north-west coast of Borneo. Its chief productions are rubber, benzine, kerosene, pepper, sago, and flour. Coal is abundant, and gold-mines are also worked. It trades chiefly with Singapore. **British North Borneo** is a British Protectorate, producing rubber, coffee, tobacco, sago, rice, spices, timber, coal and gold.

6. **Wei-hai-wei** is a territory on the Shantung Peninsula leased by the British from China. It is nearly opposite Port Arthur, and is of great strategic importance. Cereals vegetables and fruits, and ground nuts are grown. Fish is an important export. Gold, coal, and other minerals exist, but have been very little worked as yet.

7. **Iraq** (Mesopotamia), the region in Turkey in Asia between the rivers Tigris and Euphrates, was

occupied by the British during the Great War, and is now a British mandate. It is ruled by a native king, who is advised by a British High Commissioner. Its **area** is approximately 144,000 square miles, and its **population** is estimated at 2,800,000. The country is one of the most fertile in the Middle East, but under Turkish misrule its cultivation was almost entirely neglected. A system of irrigation is now being carried out by the British, and prosperity is returning to the land. It is almost entirely an agricultural country, with hardly any minerals as yet discovered, and its manufactures are few and primitive. **Wheat, barley**, and **beans** are harvested in April and May, and **rice, peas**, and **maize** in August and September. There are rich petroleum wells near **Mosul** (90,000). The chief town is **Baghdad** (170,000), and the chief port **Basra** (85,000), at the mouth of the Shat-el-Arab, the river formed by the junction of the Tigris and Euphrates.

Baghdad was ruled in the late 8th and early 9th centuries by the Caliph Haroun-al-Raschid, immortalized in the "Arabian Nights Entertainments."

The Baghdad railway is a project by which Germany hoped to obtain direct communication between Berlin and the Persian Gulf *viâ* the Bosphorus and Aleppo. The Turkish sections in Asia Minor are complete, but portions of the line in Northern Mesopotamia are still under construction. The total length is upwards of 1,500 miles. Baghdad is linked by a weekly overland motor mail service, and also by air service with Damascus.

8. **Palestine**, a portion of the Syrian Coast in Asiatic Turkey bordering on the Mediterranean, was occupied by the British, under General Allenby, during the Great War, and is now under British administration. The British Government is promoting the establishment in Palestine of a national home for the Jewish people. There are numerous Jewish colonies which are being settled on prosperous lines. The principal products of the country

are wheat, barley, maize, grapes, peaches, oranges, oil, silk, soap, tobacco, and wool. The chief animals are sheep, goats, and camels. The chief towns are Jerusalem (62,000), and Jaffa.

6. BRITISH TERRITORY IN THE SOUTH SEAS.*

1. Besides those forming part of the Dominion of New Zealand, or of the Commonwealth of Australia, the following islands in the Pacific† either form part of the British Territories, or are within the British sphere of influence:—

(1) The **Fiji Group**; Fanning Island; Christmas Island; the Phœnix, Union Group; Starbuck Island; Malden Island; the Ellice Islands; the Santa Cruz Islands; Easter Island; Ducie Island; Pitcairn Island; Dudosa Island; Washington Island; Jarvis Island.

(2) The **New Hebrides** are under the joint protection of France and Great Britain.

(3) The southern islands of the **Solomon** Group are within the British sphere of influence, and are governed from Fiji.

(4) The islands of **Western Samoa** were captured from the Germans by a New Zealand force in 1914, and under a mandate from the League of Nations have been assigned to New Zealand; **German New Guinea** and the **Bismarck Archipelago** were taken by an Australian force in the same year. Mandatory powers of government over these have been given to Australia.

(5) **Nauru Island**:—Great Britain has been granted a mandate from the League of Nations over this island. It has great deposits of phosphates, a share of which has been awarded to New Zealand. Another name for it is Pleasant Island.

2. The **Fiji Islands**, consisting of about 250 islands, islets, and rocks, lie about 1,100 miles due north of New Zealand. They form a British Crown Colony, the total **area** of which is considerably less than that of the Provincial District of Nelson, and the total population is about 162,000, of whom

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*For the geography of Australia and New Zealand see the earlier numbers of this series.

†See map showing British Empire facing page 161.

3,800 are white people, and 60,000 are coolies from India. The chief islands are Viti Levu, nearly as large as Hawke's Bay, and Vanua Levu, about half that area. The capital, **Suva**, a port of call for the New Zealand to Vancouver mail steamers, has a European population of about 1,700 persons.

Josiah Martin photo

A native dwelling, Samoa Islands.

The soil of Fiji is fertile; and the vegetation, remarkably luxuriant; the chief productions being the bread-fruit tree, bananas, plantains, peanuts, yams, coconuts, sugar cane, rice, tea, coffee, maize, tobacco, rubber, and arrowroot. The principal exports are sugar, copra (the dried kernel of the coconut, from which oil is extracted), coconut oil, and fruit.

3. **New Importance of the Pacific.** — The opening of the Panama Canal made the Pacific Ocean, and its myriads of islands, of new importance to Great Britain and her Australasian Dominions, as well as to all the rest of the world.

The shipping that passed through the Panama Canal exceeded that which passed through the Suez Canal for the first time in 1926.

The Panama Canal shortens the trade-route between New Zealand and Western Europe by some 900 miles, but it does not shorten the routes from Europe to Australia. It brings the eastern ports of the United States and Canada much nearer to New Zealand and Australia than are those of England and Western Europe. A great increase of trade with eastern America may therefore be looked for on the part of the Australasian Dominions. The produce of China, Japan, and the rest of Eastern Asia will also be more readily and cheaply transported to Eastern America and Western Europe than in the past. The Canal provided a much shorter route from all parts of the North Atlantic to the western states of South America than the old Cape Horn route. Hitherto, the Atlantic has been the great oceanic highway of the world. With the growing development and trading facilities of the lands in, or bordering on, the great Eastern Ocean, the Pacific will probably in time become the chief commercial waterway of the world. The importance of the Panama Canal, the great commercial artery linking together the Pacific and the Atlantic, and of its bearing on Australasian trade, can therefore be hardly over-estimated.

TWO COUNTRIES OF SPECIAL IMPORTANCE TO BRITISH PEOPLE.

1. THE UNITED STATES OF AMERICA.

1. Reasons for its Importance.

1. The **United States of America** is of importance to the British people for the following (as well as for other) reasons:—

(1) It once formed part of the British Empire, and was colonized by English, Scotch, and Irish settlers, whose descendants, together with those of later British immigrants make up the dominant section of its population to-day.

(2) It is the only foreign power whose people are mainly of British descent, and who in their daily intercourse, and in their literature, use the English language.

(3) Its aims and interests are to a considerable extent very similar to those of the British Empire, with different parts of which it carries on a great trade. Canada, the largest of the British Dominions is separated from it by merely a geographical line several thousand miles in length; and between Canada and the United States there is the very closest commercial intercourse. Australia and New Zealand, too, are connected with it by mail and trading steamers and by the mutual interchange of commercial products. Now that the Panama Canal is open New Zealand and Australia are, commercially, much nearer to the eastern ports of the United States than to any of the ports of Britain or Western Europe.

(4) It has been arranged between the governments of Great Britain and the United States that in future all material differences between them shall be settled, not by the arbitrament of war, but by peaceable arbitration.

(5) America was of great importance to the British and French in the Great War, towards the close of which it fought on the side of the Allies. It is now probably the wealthiest country in the world.

2. Area, Population, and Commercial Position.

The United States is larger than Australia, and nearly as large as Europe. Including Alaska, it is a trifle larger than Canada. Its **population** exceeds 118 millions, and is increasing rapidly. About a hundred years ago it did not exceed 4 millions.

Lying between Canada and Mexico, and extending from the Atlantic Ocean to the Pacific, the United States has this commercial advantage over the Great Dominion; namely, that its southern coast is bordered by the Gulf of Mexico into which the waters of a mighty river system flow, bringing down the rich products of a vast and fruitful area. The Atlantic ports trade readily with Europe, Africa, and South America; and the Pacific ports, with eastern and southern Asia, the islands of the Pacific, and the Australasian Dominions.

3. Surface.

The United States consists, geographically, of five main divisions:—(1) the **Atlantic Coastal Plain**; (2) the **Appalachian Highlands** (including the Alleghany Mountains; (3) the **Great Central Plain**, forming the basin of the Mississippi and its tributaries; (4) the **Western Plateau**, extending from the **Rocky Mountains** to the **Sierra Nevada**, and the **Cascade Chains**, and including the basins of the Columbia and Colorado Rivers; and (5) the **Pacific Slope**, stretching from the crests of the last-named mountains to the Pacific Ocean, and including the Coast Range and Sacramento Valley.

4. Industries and Commerce.*

1. The chief industries of the United States are those connected with agriculture, manufactures, mining, commerce, and the forests and fisheries. About one quarter of the people are engaged in agricultural pursuits, and another quarter in manufacturing industries. The chief articles of manufacture are cottons, woollens, machinery, iron and steel goods.

Maize, or Indian corn, is grown principally in the States irrigated by the Missouri and Mississippi before their junction. The **wheat** growing region occupies the central states near the Great Lakes and the upper valleys of the Mississippi and the Red River. **Cotton** is grown in the States of Texas, Mississippi, and Arkansas, which supply the greater part of the world's raw cotton. The chief **tobacco** producing States are North Carolina, Kentucky, and Virginia. The **sugar cane** is grown extensively in the delta lands of Louisiana. **Lumbering** (timber) is a prominent industry in the north-east, and along the southern shores of the Great Lakes. **Coal, iron,** and **petroleum** are found in great abundance near Pittsburg and Chicago. **Petroleum** is produced also in Texas. Some of the coal-fields cover an area larger than that of Great Britain. **Copper** is obtained from the shores of Lake Superior; and **gold,** and

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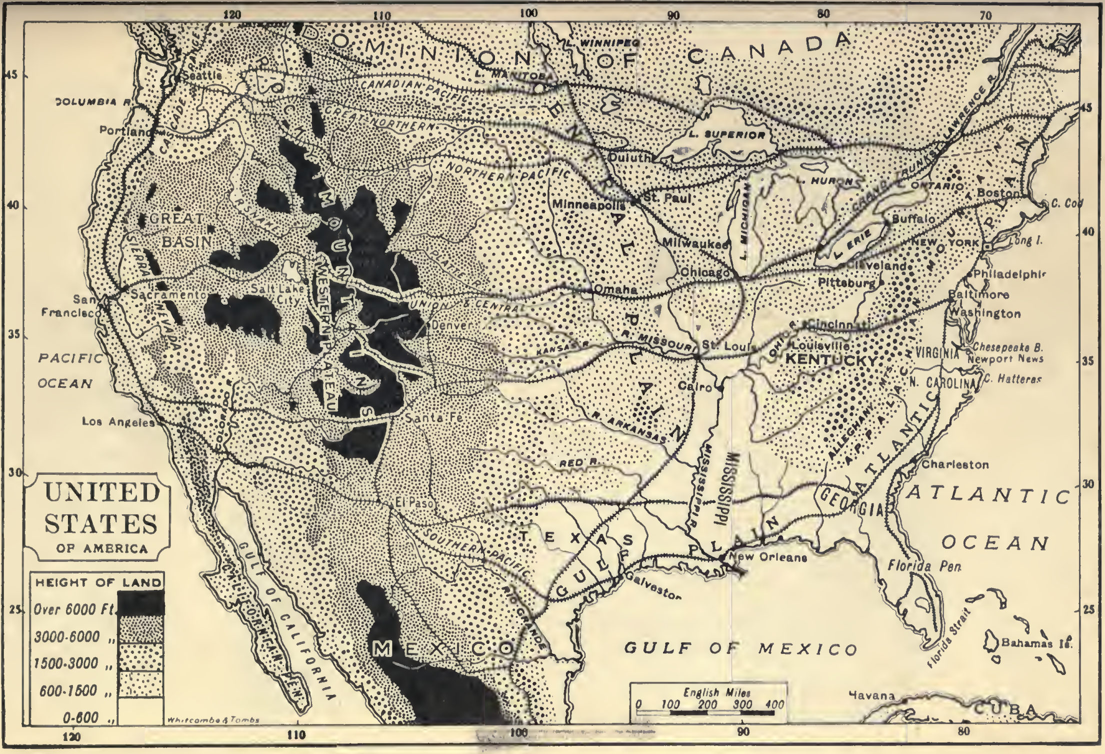
*For map of principal products of U.S.A. see page 170.



Note.—The railways shown are the main trans-continental lines together with the chief Canadian connections at Detroit, Sault Sainte Marie (Soo), Winnipeg, and Vancouver.

silver, from the country lying between the Rocky Mountains and the Pacific. **Cattle-rearing** is largely carried on along the eastern slopes of the Rocky Mountains, as well as in other places, The States of California and Florida excel in fruit-growing.

Underwood and Underwood, photo

Cotton picking, Georgia, U.S.A.

2. The foreign **commerce** of the United States is very extensive; her principal customers being Great Britain, Germany, France, Canada, Australia, and New Zealand. The chief **exports** are cotton, grain, bacon, tobacco, and petroleum (to Britain); petroleum

(to Germany, Australia and New Zealand); flour and timber (to the West Indies and South America); gold, silver, and tobacco. The principal **imports** are iron and steel goods (from Britain); wines and silks (from France); tea, raw silk, and china-ware; coffee (from Java and Brazil); and other colonial products. The inland trade is enormous, owing to the interchange of the varied products of one State with those of

Underwood and Underwood photo

Irrigating Oranges. California.

another; the trade with the neighbouring countries, Canada and Mexico, is also very considerable.

5. Government.

1. The United States form of government is republican; the country consisting of a number of federated States. The Federal Parliament meets at Washington, the capital of the Union. It consists of two houses—the Senate, elected by the State Legislatures, and the House of Representatives.

Underwood and Underwood, photo

Buildings in New York.

chosen by the people. The **President** is the head of the Government, and also the Commander-in-Chief of the army and navy. He is chosen by the vote of electors appointed by each State, and holds office for a term of four years.

Underwood and Underwood, photo

Sugar for export, New Orleans.

2. Each State has its own local legislature, consisting of a Governor and two Houses of Parliament, to make laws for itself in accordance with the Constitution.

6. Great Cities and Ports.

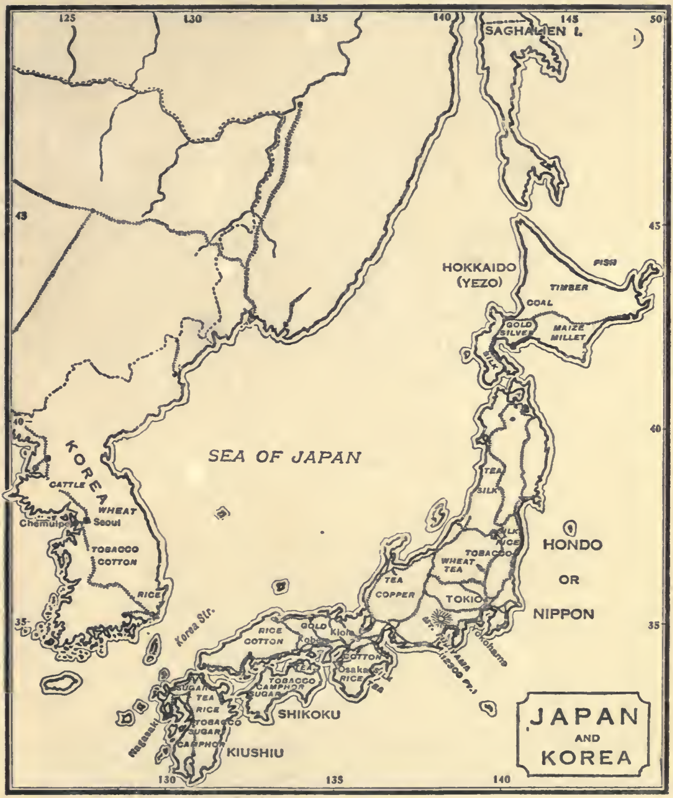
The chief ports on the Atlantic Coast are **New York,** the second largest city in the world; **Philadelphia**, the second city of the Union; **Boston,** the literary capital of America; **Baltimore,** a great manufacturing centre, with exports of grain, flour, and tobacco. Near the southern coast, about 100 miles from the mouth of the Mississippi, is **New Orleans**, the greatest raw cotton town in the world, with exports of cotton, sugar, tobacco, and other produce of the Mississippi Valley. On the west coast the chief port is **San Francisco**, having steam communication with China, Japan, the East Indies, the Pacific Islands, and New Zealand, and connected by transcontinental lines of railway with New York and other east coast ports.

Large inland towns are:—**Chicago**, on Lake Michigan, the greatest grain and provision (beef, mutton and pork) market in the world; **St. Louis**, at the junction of the Missouri and Mississippi, one of the busiest river ports in the world; **Cincinnati**, on the Ohio, the greatest pork market in the world; and **Pittsburg**, the centre of a rich coal, iron, and petroleum district that supplies a natural gas largely used instead of coal or oil in the manufacturing industries. Other important inland centres are **Cleveland** (iron and petroleum works); **Buffalo** and **Detroit** (timber and grain); **Milwaukee** (a large grain shipping port on Lake Michigan); **Duluth** (wheat, and iron ore) in the extreme west of Lake Superior; **Louisville** (tobacco trade); **Minneapolis** and **St. Paul** (centres of wheat growing. with flour mills).

2. JAPAN.

1. Importance to the British Empire.

Japan, consisting of a long cluster of islands, some 550 in number, is of importance to the British, particularly to the people of New Zealand and Australia, for the reason that Great Britain and Japan have by treaty agreed to maintain each other's territorial rights in the Western Pacific, and to defend them by force, if necessary, against the interference or encroachment of other Powers. As



Japan is a strong military and naval Power within easy sailing distance of the Pacific Dominions, this treaty makes it dangerous for any other Power to attack Britain in the Pacific, and therefore places on a safe footing the interests of Australia and New

Zealand. During the Great War, Japan, as the ally of Great Britain, rendered great assistance to our Empire. and particularly to Australia and New Zealand, in helping to convoy our Expeditionary Forces to their destinations, and in keeping free the great oversea trade-routes. etc. Japan also offers a future market for the produce from Australia and New Zealand, such as wool and wheat.

2. Area, Population and Government.

1. Japan is an Archipelago in the North Pacific, lying to the east of Asiatic Russia and China. Its **area** (excluding Korea, Formosa, the Pescadores, and Saghalien), is about 148,000 square miles; and its population is 62 millions. As a result of the successful war with Russia in 1905, Japan gained the southern part of Saghalien Island, and a virtual Protectorate over Korea (**area** 85,000 square miles; **population** 19,500,000). Kiao Chau, captured from Germany by Japan in 1914, was returned to China in 1922.

The original people of Japan were a race of black Caucasians, known as "the Hairy Ainu," who were probably allied to the Blackfellows of Australia. Some of them are still found among the northern mountains of the country. The present Japanese are of the same **Mongolian** race as the Chinese, but are descended from a different section of it. At a very early date the Japanese invaded the Archipelago from the mainland of Asia, and conquered the Ainu.

Before 1889 the Mikado, or Emperor, was the absolute ruler of Japan; but since that date the country has been governed by the Mikado and the Diet, a parliament somewhat similar to the British Parliament.

3. Industries and Commerce.

Two-thirds of the people of Japan are engaged in **agriculture**, the land being largely occupied by peasant proprietors. The **chief products** are rice and other grain, tea, sugar and silk, while textile (cottons, silks, woollens), and other manufactures (paper, matches, leather, and earthenware) are increasing rapidly. There are large **coalfields** in the Empire, while iron, gold and silver are also mined. About two-thirds of the total area of the country is occupied by **forests**, half of which are State forests. There are nearly 10,000 miles of railway in the country, the greater portion of which is owned by the State. The principal commerce is with the United States, China, British India, Great Britain, and Australia.

4. Capital and Chief Ports.

Tokio (1,900,000) is the capital of Japan. **Osaka** (2,000,000), and **Kioto** are other populous towns. The two chief ports are **Yokohama** and **Kobe**. **These are the chief centres of foreign trade.**

APPENDIX.

Chief Trade Routes of the World.

1. The chief ocean trade routes of the world are:—

(1) Those across the Atlantic from Europe to America.

(2) Those from Europe, through the Mediterranean and Red Seas to Southern Asia and Australia.

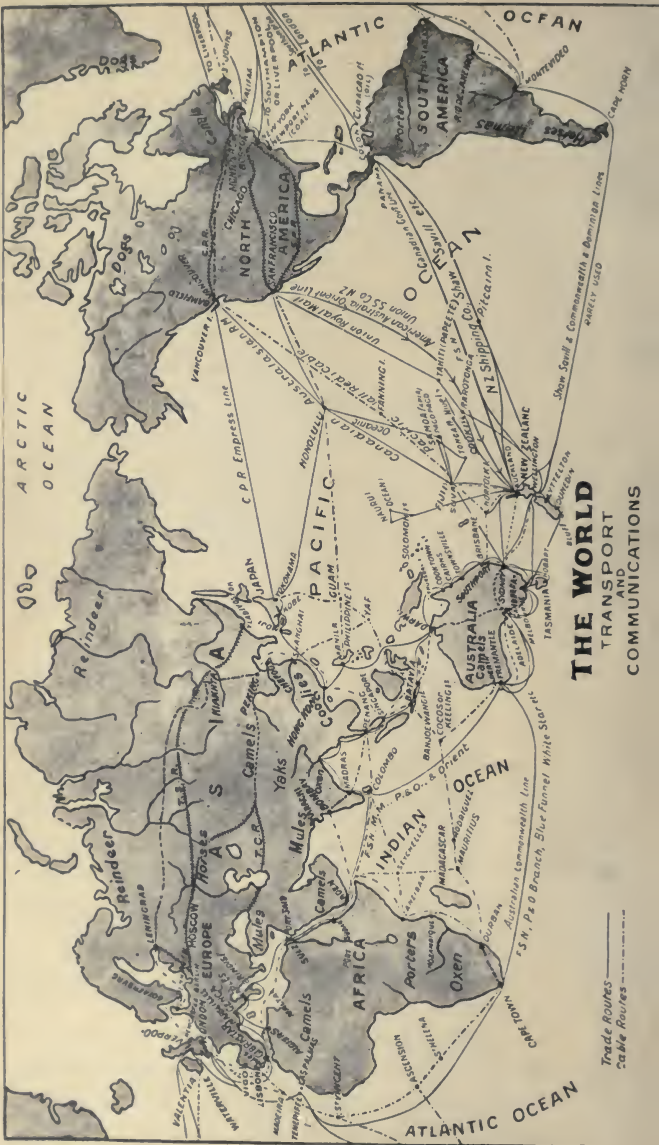
(3) From Europe to the Cape of Good Hope, and thence to southern and eastern Asia and Australia.

(4) Across the northern Pacific, from Canada and the United States to China and Japan.

(5) Across the central Pacific, from the United States and Canada to New Zealand and Australia.

(6) From south-eastern Asia, Australia, and New Zealand, across the Pacific, *viâ* the Panama Canal to eastern America or Europe.

2. These and other sea-routes may be learned most conveniently by a study of the map of the chief Trade Routes on the next page, which also shows the chief cable routes of the world.



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